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TOWNSITE EXPANSION STUDY - FORT SIMPSON, N.W.T.

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EXPANSION STUDY

FORT SIMPSON, N.W.T.

Prepared by

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for the

Government of the

Northwest Territories

January 1974

Environmental-Social Committee
Northern Pipelines
Task Force on Northern Oil Development
Report No. 74-27

The data for this report were obtained as a result of investigations carried out under the Environmental-Social Program, Northern Pipelines, of the Task Force on Northern Oil Development, Government of Canada. While the studies and investigations were initiated to provide information necessary for the assessment of pipeline proposals, the knowledge gained is equally useful in planning and assessing highways and other development projects.

This report is advisory to the N.W.T. Government, it is not final and will be subject to review with the community council. All dollar figures contained in the report are subject to normal financial constraints.

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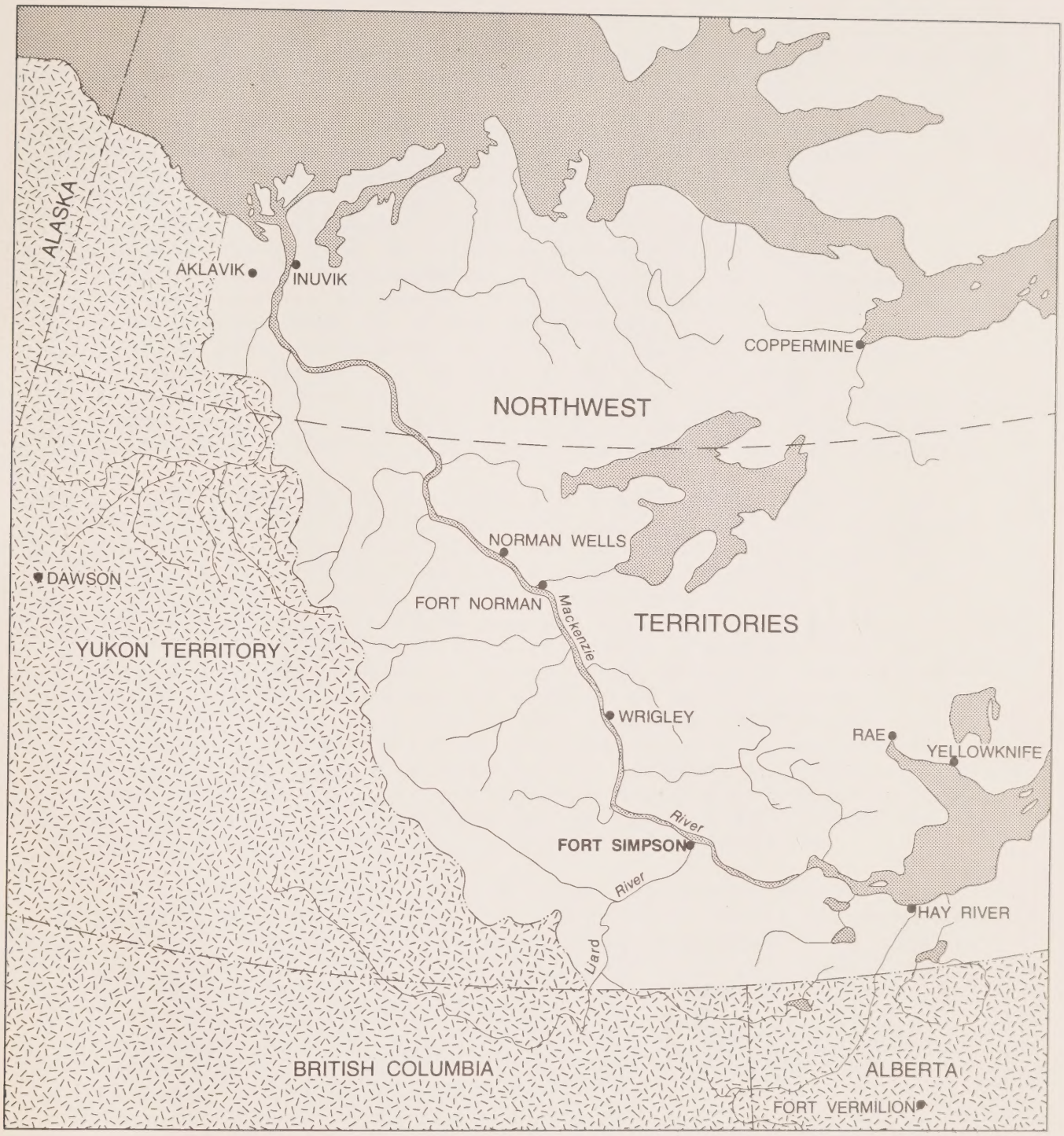
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RAPPORT ABRÉGÉ - FORT SIMPSON (T.N.-O.)

Ce rapport expose les conclusions d'une étude d'expansion concernant le village de Fort Simpson (T.N.-O.).

Fort Simpson est un centre qui offre des services hospitaliers et éducatifs (jusqu'à la 9e année) pour la région du Haut-Mackenzie, située au sud de Norman Wells et au nord-ouest de Fort Providence. C'est là où s'arrête actuellement la route du Mackenzie et où commence la vallée de la rivière Liard. La poussée expansionniste provoquée par ces facteurs est maintenant intensifiée par le projet de l'installation prochaine d'un gazoduc dans la vallée du Mackenzie et par la construction, commencée en 1972, du nouveau tronçon de la route du Mackenzie devant relier Fort Simpson à l'Arctique. Fort Simpson offre des possibilités intéressantes comme centre de transport et pour l'industrie reliée à cette dernière activité et aux ressources forestières et agricoles.

L'expansion de Fort Simpson a grandement dépassé les prévisions antérieures, de sorte qu'il y a eu un épuisement rapide des terres réservées pour la collectivité de l'île. En 1972, le système d'approvisionnement en eau du village a atteint sa capacité maximale. Au début de 1973, une conduite d'eau tenporaire amenant de l'eau des sources situées sur la terre ferme a dû être installée d'urgence afin de satisfaire aux besoins en eau d'usage ménager. Le plus grave, c'est que, actuellement, le système ne permet pas une réserve d'eau suffisante pour lutter efficacement contre les incendies. Un morcellement industriel projeté en 1970 et accru en 1973 est en grande partie réalisé; le besoin immédiat d'aménagements adaptés aux maisons mobiles se manifeste par la présence d'une trentaine de roulottes établies sur des terrains déjà occupés ou impropres à l'habitation.

La population de Fort Simpson est passée de 495 habitants, en 1956, à 1,284 en 1973. Le taux moyen annuel de croissance a augmenté considérablement ces dernières années, et toutes les prévisions basées sur des données pour le passé ou sur les règles normales de croissance ne peuvent s'appliquer à l'heure actuelle à Fort Simpson. Par conséquent, on considère que l'expansion démographique future de cette agglomération dépendra dans une large mesure des nouvelles influences venant de l'extérieur.

L'augmentation possible de la population, causée par le développement industriel, a été étudiée à la fois pour l'industrie temporaire reliée à la construction du gazoduc projeté et à la route du Mackenzie, et pour l'industrie permanente ou à long terme créée par le transport et d'autres

activités. On prévoit que l'industrie temporaire occupera la plus grande partie des terres dans les années à venir, mais il y a aussi de grandes possibilités de créations d'industries durables reliées aux ressources forestières de la région, au transport et à l'agriculture.

La construction du gazoduc projeté n'aurait que très peu d'effets sur la croissance de Fort Simpson d'ici trois ou quatre ans et n'affecte donc pas la planification dans l'immédiat de l'expansion de cette localité. Cependant, la planification pour la période de 1977 à 1980 serait considérablement modifiée si la construction du gazoduc devait subir un retard important.

On prévoit que la population de Fort Simpson continuera à augmenter, pendant une longue période, à un taux annuel moyen de 7 %, et que cette localité comptera 3,000 habitants en 1988 et 7,000 en 1'an 2000. On estime qu'avec la construction immédiate du gazoduc, Fort Simpson compterait environ 3,000 habitants dès 1980, mais que le chiffre de 7,000 ne serait atteint que quelques années avant 1'an 2000. Par conséquent, les plans pour 1'expansion résidentielle sont fondés sur une population totale d'environ 7,000.

Les terres qui pourraient servir à 1'expansion résidentielle dans 1'île de Fort Simpson, emplacement actuel de la localité, sont très peu nombreuses. En raison de 1'augmentation démographique prévue, 1'expansion future devra se faire sur la terre ferme. On a fait des estimations des besoins en terres pour 1'expansion industrielle et résidentielle et plusieurs emplacements éventuels ont été étudiés. Les emplacements les plus propices ont été choisis et des plans ont été élaborés. Les réseaux routiers et les services publics existants ont été analysés, et des plans pour 1'amélioration et 1'expansion futures ont été établis.

Le rapport recommande un programme destiné à assurer la croissance et le développement ordonnés de Fort Simpson pendant la période d'expansion que devrait connaître cette localité au cours des sept prochaines années. Ce programme prévoit, à 1'intention de la population future, 1'aménagement d'espaces pour les maisons mobiles et de lotissements résidentiels sur la terre ferme; le programme comprend aussi des plans pour les développements commerciaux, institutionnels et industriels qui deviendront nécessaires.

Des prévisions portant sur les besoins estimatifs en fonds nécessaires pour la réalisation du programme de développement recommandé, ont été établies; ces prévisions indiquent que le coût total d'une telle réalisation sera de $3,353,000 jusqu'en 1980 (coût en décembre 1973).

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I. INTRODUCTION

This report presents the findings of a "Townsite Expansion Study" for the Village of Fort Simpson, N. W. T.

Terms of reference for this study were established in August, 1972 by the Government of the Northwest Territories, Department of Local Government. The work was done in association with Clark, Swanby and Associates Ltd. The consultant requested:

to evaluate development potential;

to predict growth of the community;

to assess land and utility requirements for anticipated growth;

to recommend the most favourable site for the predicted expansion;

to prepare a master plan for the expansion;

to prepare cost estimates for all expenditures, including additional investigations, required for the implementation of the townsite expansion; and,

to establish a program of development over a seven year period.

An interim report was submitted in December, 1972 for review by the Government of the Northwest Territories, and by the Council of the Village of Fort Simpson. The consultant was instructed to extend the completion date of the final report in order to allow incorporation of the findings of the "Mackenzie Valley Social Impact Study" prepared by Gemini North Ltd. and of the "Granular Materials Inventory" prepared by PEMCAN Services "72".

Growth of Fort Simpson has greatly exceeded previous predictions, resulting in rapid depletion of the island community's land reserves. The Village water supply system reached absolute capacity in 1972, and an emergency temporary water line from springs on the mainland was installed in early 1973 to provide domestic water flows for 1973 requirements. More serious, the water system will no longer support an effective fire-fighting capability, in terms of water storage under present conditions. An industrial subdivision designed in 1970 and expanded in 1973 is largely "sold out", and the immediate need for suitable mobile home accommodation is evidenced by some thirty trailers "squatting" on properties already occupied or unsuitable for residential occupancy.

Fort Simpson is an institutional centre, providing hospital and educational facilities (to grade 9) for the upper Mackenzie region, south of Norman Wells and northwest of Fort Providence. It is the present terminus of the Mackenzie Highway, and serves as the entrance to the Liard River valley. The development impetus provided by these functions is now being amplified by anticipation of the proposed Mackenzie Valley gas pipeline and by the start of construction in 1972 on the new Mackenzie Highway extension from Fort Simpson to the Arctic. Fort Simpson displays potential as a transportation centre and for industrial growth related to transportation, forest products and agriculture.

II. PREVIOUS STUDY WORK

In this study, reference was made to the reports of previous studies by others, and including:

1. 1962: "A Preliminary Study of Possible Sites for a Northern Capital," (C.M.H.C.). In this study, several possible development sites are compared, and the recommendation was made for development of "Site B", referred to in the current study as the "CMHC Site." This site is located west of the Liard some four miles south of the island along the Mackenzie Highway. The CMHC study considered a possible population of 5,000 persons in Fort Simpson as the NWT capital. The study projected a possible population on the island of 2,645 to 3,250, depending on the type of residential unit.

2. 1961: "Terrain and Sites Analysis of Fort Simpson, N.W.T.", (R.T. Gajda), Department of Mines and Technical Surveys. An investigation of surface soils, climate and terrain for the island.

3. 1962: "Fort Simpson, N.W.T. - Engineering Site Information; Soil and Permafrost Conditions," (J.A. Pihlainen), Technical Paper 126, D.B.R. National Research Council. An investigation of soils and permafrost on the island. This study related permafrost to land occupation and provided a historical resume of land occupation and development on the island.

4. 1966: "Fort Simpson, N.W.T. - Planning Report and Development Plan," (Makale, Holloway and Associates). This study analyzed the existing community in 1966 in detail, and provided a development plan for a total population of 1,284 persons, which population has now been exceeded. It also made recommendations with regard to transportation, utilities, administration and community services.

5. 1969: "Forest Inventory Survey and Development Study of the Lower Liard River Area," (F.F. Slaney and Company Ltd.) A study of forest products potential in the lower Liard valley. This study recommends a road to connect Fort Simpson to Fort Nelson through Fort Liard, to open up this timber area and recreational sites, and indicates some

potential for lumber milling in the Fort Simpson area.

6. 1970: "Preliminary Appreciation of Prospects for Forest Conversion Plant Development in the N.W.T.", (C.D. Schultz and Co. Ltd.). This report shows a market and a supply for profitable operation of a 10,000,000 board foot mill at Fort Simpson.

7. 1970: "Physical Development Proposals for the Hamlet of Fort Simpson, N.W.T.", (Clark, Swanby and Associates Ltd.). This report presented a replot of a residential area, and presented recommendations for siting a mobile home park, an industrial area and a commercial area, all with detailed plans. The report also examined expansion sites on the mainland.

8. 1972: "Engineering Analysis of Services, Hamlet of Fort Simpson", (U.M.A. Group). The U.M.A. report reviewed existing utilities, and provided recommendations for improvements to sewer and water facilities with cost estimates.

9. 1973: "Mackenzie Valley Social Impact Study," (Gemini North Ltd.). A study on the effects upon communities within the area of influence of proposed and predicted developments concerning oil and gas related activities, including pipelines, in the Mackenzie region. This study examined the impact of proposed development in the Mackenzie Valley on the Village of Fort Simpson, and included population growth projections for the Village to 1980.

10. 1973: "Granular Materials Inventory, Fort Simpson, N.W.T., Community Study Area," (PEMCAN Services "72"). An investigation of the availability of granular material deposits within a ten mile radius of Fort Simpson.

No attempt was made to duplicate study work done by others, except as appeared necessary due to changed conditions or requirements. The other work is catalogued here for the purpose of providing specific references and background to the current study.

III. INDUSTRIAL DEVELOPMENT

Industrial development potential falls into two types:

- transient industry associated with construction of the proposed gas pipeline and the Mackenzie Highway, and,
- permanent or long-term industrial potential created by the transportation industry and other activities.

Transient industry is anticipated to be the greater land use factor over the next four years, but a strong potential exists for the development of long-term industrial enterprises, related to the nearby timber resources, transportation and agriculture. An effort should be made to prevent transient industry from acquiring permanent sites, possibly forcing long-term industries further away from the community than is necessary. Two measures are proposed:

1) Leasing rather than sale of land for transient industry.
2) Reserving closer sites for long-term industrial establishments.

In addition, consideration should be given to sequential use of industrial sites, e.g. conversion of pipe storage yards to sawmill log yards and lumber storage. Consideration of such sequential uses would have an influence on areas cleared, roads constructed, power and other services, and location of transient industrial sites.

Transient industry is foreseen to include the following specifics:

1) Mackenzie Highway Extension:

There are presently four camps in the Fort Simpson area and this number is expected to remain stable during construction of the Mackenzie Highway from 1973 to 1975. The effect of these camps on the community of Fort Simpson has not been great, but an increase of about 50 families is expected to be maintained over the next three years as a direct result of highway construction. The four camps each comprise 30 to 70 men, with some attendant economic effect on Fort Simpson commerce.

2) Gas Pipeline Construction:

At the present time, it appears that construction of a gas pipeline from the Mackenzie Delta could commence in 1977. An application to D.I.A.N.D. for a right-of-way permit is anticipated in 1974. Following this, an application for a National Energy Board permit would be submitted and final approval probably obtained in 1976.

If the above timing is accurately predicted, a logistical operation would commence at Fort Simpson and at Arctic Red River in 1976. Work would include preparation of storage yards, preliminary physical work on the pipeline right-of-way, campsite preparation, materiel operations and establishment of pipeline and government offices.

In addition to pipeline laying, a strong possibility exists of a "double-jointing" operation being established at Fort Simpson, requiring a yard and works for welding pipeline lengths together.

This operation would be established at either Providence or Fort Simpson, where pipe is off-loaded from trucks, and could establish Fort Simpson as a barge terminus for the Mackenzie waterway.

N. W. T. Government liaison anticipates 50 to 75 families to locate in Fort Simpson for the years 1977 through 1979 during pipeline construction, largely as temporary residents.

3) Construction-Oriented Industry:

The servicing of major construction operations on the highway and pipeline will generate a demand for support industry such as machinery and vehicle repair, welding and machining, bulk fuel storage, and pipe inspection services. Freight handling will provide a requirement for a trucking terminal and expansion of air freight facilities. A major barge operation could be established in connection with pipe transportation, requiring a large storage area.

The construction servicing industry that actually locates in Fort Simpson will be dependent upon the initiative of the private enterprise sector, and service that is not provided from this sector will be imported as a part of construction operations. Certain of these service industries would have a continuing market associated with highway traffic and pipeline operation, and possible development of a forest industry. Such industry would be beneficial to the community in terms of permanent employment and commerce, and as such should be encouraged.

It is estimated that construction service industry will provide employment for 60 people over the years of pipeline and highway construction, 1974 to 1979 inclusive. This employment will be created either in private industry or as additional labour force for construction operations.

Permanent industrial expansion at Fort Simpson will likely occur more gradually than transient industry, and is much less predictable. Permanent industry is foreseen to possibly include the following specifics:

1) Gas Pipeline Operation and Maintenance:

It is anticipated that one of two main centres for pipeline operation will be located at Fort Simpson. It is estimated that this centre, together with maintenance of pipeline and compressor stations and continuing minor construction will provide permanent direct employment for 50 persons beginning in 1979.

2) Highway Maintenance:

The N. W. T. Government indicates that if maintenance of the Mackenzie Highway is conducted as a hired labour operation there will be a six-man crew stationed at Fort Simpson, beginning in 1975. Completion of the Fort Nelson - Fort Simpson highway would probably expand this crew to ten men. If maintenance is performed as a contract operation, it can be assumed that the required work force will be of similar size.

3) Highway and Barge Transportation:

Residual industry from construction operations redirected to highway transportation will be relatively

minor, unless Fort Simpson becomes a major truck centre. In this connection, consideration is being given to establishment of a major sales and overhaul depot in Fort Simpson by oné of the major truck manufacturers, but no definite plans have been approved by this firm to date.

The early establishment of Fort Simpson as a barge terminal will probably depend on pipeline logistics. A site on the Liard, south of the ferry, has been reserved by Kaps Transport, possibly in speculative anticipation of a requirement for facilities by pipeline operations. However, Fort Simpson has definite advantages over Hay River for trans-shipment of trucked freight for Mackenzie waterway barging. The opening of navigation from Fort Simpson generally occurs three to four weeks ahead of breakup on Slave Lake which delays navigation from Hay River. Some study has been given to a railway line from Fort Nelson to Fort Simpson, but such a link is not foreseen in the immediate future. Hay River, as end-of-rail, will continue to provide trans-shipment service from rail to barge. A barge terminus at Fort Simpson would establish barge and tug repair service here as a matter of course.

4) Forest Products:

Two studies commissioned by the N. W. T. Government (Slaney, 1969 and Schultz, 1970) demonstrate definite potential for a sawmill at Fort Simpson, drawing from the resources of the lower

Liard Valley and the surrounding district of the Mackenzie and Slave Lake areas. The market which could be penetrated by an operation at Fort Simpson is determined by transportation costs, and would be enlarged by removal of a surcharge on south bound rail freight. However, a mill producing ten million board feet annually appears to be feasible at the present time, and it would seem reasonable to anticipate that such a mill could be established and operational before 1980. There has been sawmill experience in Fort Simpson in the past, and changed market conditions may regenerate this industry.

Construction of the Fort Simpson - Fort Liard portion of the Fort Nelson to Fort Simpson highway, anticipated (by Gemini North) in 1977-78, would provide a constant supply of timber to a mill at Fort Simpson. This would ease the financial problems associated with inventory and camp operations necessary for winter-road log haul.

Fort Simpson appears to be an excellent site for production of prefabricated homes. The advantages of water and road transportation to a prime market area, coupled to a possible source of economical lumber, could provide incentive for establishment of this industry. Establishment of a sawmill at or near Fort Simpson would also create possibilities for plywood and chip-board manufacturing.

The potential exists, then, for employment of at least 50 native people and a like number of whites in a forest products conversion industry at Fort Simpson.

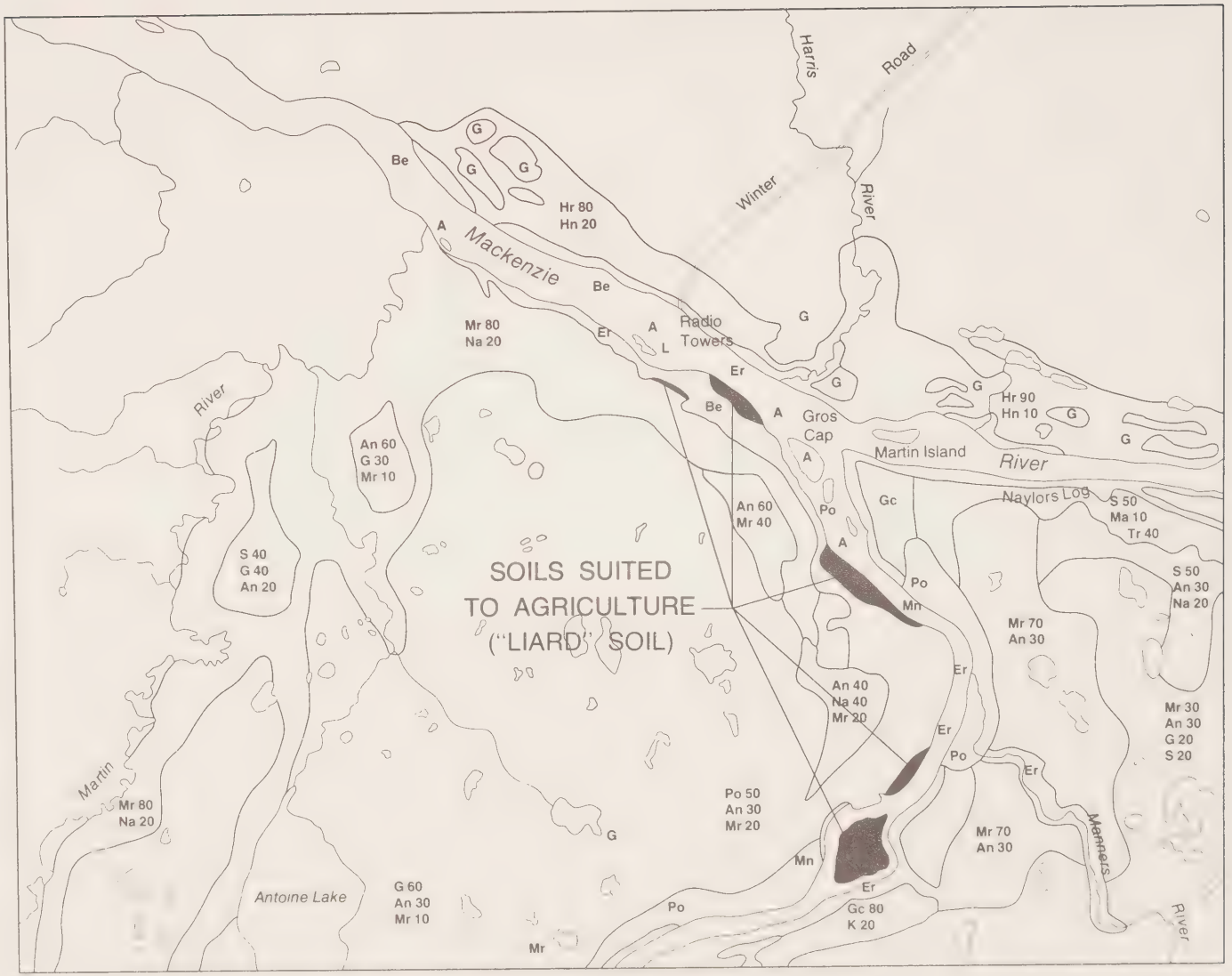
5) Agriculture:

Fort Simpson has demonstrated soil and climactic conditions suitable for agriculture, and particularly for growth of root vegetables. In addition to areas on the island previously cultivated as a Dominion Experimental Farm, and gardens for the island missions, suitable soil is found along the Liard for market gardening of all root vegetables. These areas are shown on the agricultural area drawing included in this report, (Figure 2) and comprise approximately three square miles.

Rising costs of vegetable production, hauling and transportation, have raised the retail price of vegetables throughout the Territories to a new height. A gardening operation at Fort Simpson is now considered to be potentially profitable, as well as agriculturally feasible. Gardening could be carried out as a government supervised cooperative venture, if private enterprise does not initiate this industry. With experimental farm expertise still available in the community, the potential of gardening should be fully investigated. Employment for approximately 40 native people and 20 others, all on a half-year basis, is anticipated from such a venture, plus employment for additional people in marketing and transportation, perhaps 10 persons on a year-round basis.

In anticipation of a gardening industry, it is strongly recommended that the areas on the mainland suitable for gardening be reserved indefinitely. The remaining areas on the island which have

previously been cultivated should be released to development. Their value as serviceable, well located residential properties far exceeds their value as agricultural land; ample good soil is available on the mainland to support a large gardening industry.



SOILS MAP OF FT. SIMPSON AREA

IV. POPULATION

A. Historical

Previous predictions of population growth based on conservative percentages related to birthrate and historical growth of the community have not proven realistic. In fact, Fort Simpson has been affected by the highway link to Alberta and the Slave Lake region to the extent that it is no longer a stable community, growing in accordance with normal southern standards and laws. The population of the settlement has more than doubled in the past ten years, to a total current population of 1,284 persons. Rate of growth is shown by the following counts:

1956	495 persons (D.B.S.)
1961	563 persons (D.B.S.)
1966	732 persons (Makale Holloway)
1971	1,000 persons (Village)
1972	1,200 persons (Village)
1973	1,284 persons (Gemini North)

From the above, the average annual rate of growth, 1956 to 1961, was 2.6 per cent; from 1961 to 1966, 5.4 per cent; from 1966 to 1971, 6.4 per cent; and over the past two years, 13.3 per cent. It is obvious that any projections of growth based on historical data or normal growth rules do not apply to Fort Simpson at this point in time.

It should be noted that D.B.S. census figures have been found to be considerably lower than figures compiled locally from voter's lists and student enrollment. For this reason, population growth rate computations may be inaccurate when census figures from various sources are used. However, Village counts are considered the more reliable and have been used where available.

B. Growth Factors:

The future growth of Fort Simpson will be almost directly related to new outside influences, viz.:

1) Mackenzie Highway Extension:

Fort Simpson will be a service centre on this road, providing accommodation and vehicle service. It is estimated that new employment for approximately 70 persons will be created by this requirement in service stations, motels and restaurants, and the net increase in population attributable to highway service functions will ultimately be about 100 persons. In addition, the establishment of a major truck repair shop and possibly sales outlet at Fort Simpson is probable, particularly if lumber operations develop, and an increase of another 30 to 40 persons could arise here. Highway maintenance based in Fort Simpson is estimated to create a net increase in population of 20 persons beginning in 1975. Construction of the highway is expected to add about 175 persons for three years, 1974-1976, as temporary population.

2) Gas Pipeline Construction and Operation:

Construction of a gas pipeline is anticipated to commence in 1977. The N.W.T. Government is advised that construction operations will likely add 150 to 200 people to the Fort Simpson population in terms of construction workers and their families, for the years 1977 through 1979. Some part of this increase should occur in 1976 for logistical work, estimated at 50 persons.

If a "double-jointing" operation for pipeline

assembly work is located at Fort Simpson, a further increase of 50 to 70 persons will result for the construction phase.

Upon completion of the pipeline, probable establishment of a compressor station and operations centre is expected to result in a residual population effect of 175 persons, from 1979 onward, including support people and increased government personnel associated with pipeline operation.

3) Industrial Expansion:

The servicing of major construction operations on the highway and pipeline will generate a demand for support industry such as machinery and vehicle repair, welding and machining, bulk fuel storage, and pipe inspection services. Freight handling will provide a requirement for a trucking terminal and expansion of air freight facilities. A conservative number of new workers in this type of industry would appear to be about 60 persons, with a net growth effect of about 100 in the community.

New industry of independent origin and based on forest products, barge transportation and possibly forest product utilization (e.g. prefab houses) could add 300 people to the community. Agriculture in the form of market gardening appears to have great potential in view of prevailing prices for vegetables in the Mackenzie and Slave Lake centres. While such activity would be largely based on local native labour, in the fields, the absorption of this local labour and the associated functions of transportation and marketing would create new population estimated at

50 to 150 persons. As with forest product industry, agricultural development could occur at any time or not at all, but a potential exists and possible resultant population increases should be considered in some fashion, if not definitely predicted.

4) Institutional Growth:

The new hospital at Fort Simpson has greatly improved facilities as compared to the old hospital. As a result, a gradual increase in utilization is anticipated, with an ultimate staff increase of 25 to 30 employees anticipated. This will generate a growth of at least 80 persons for Fort Simpson over the next three to four years.

It is anticipated that other growth will produce a student population sufficiently large to maintain a diploma course high school at Fort Simpson. This would mean retaining at least 100 more students in Fort Simpson and providing a staff of at least 20 for a high school, with a net increase in population of 160 persons, probably by 1978. In addition, an increased number of students in existing grades (1 to 9 incl.) will require additional staff for their education. Doubling of the student body by 1978 would require an additional staff of 25 persons, and would generate a net increase in population of 50 to 60 persons, or an annual average increment of some 15 people for this function.

5) Government:

Government has been a prime employer in Fort Simpson which serves as an area centre for N.W.T. administration and for educational administration. With anticipated development of the highway extension,

pipeline, and possibly a forest industry and agricultural enterprises, it is expected that the ratio of government employment of total employment will not be maintained at previous levels of approximately 55 per cent, (Makale Holloway, 1966). Gemini North has predicted an increase of 345 in the demand for Government of the N.W.T. personnel in the eight high impact communities by 1980. Based on its proportion of the 1972 population of these communities (1,200 out of 9,050), Fort Simpson would experience an increase of 46 government employees. With an average family size of 3.5 persons, this would result in a growth of 161 persons in the population of Fort Simpson by 1980.

6) Commercial Service:

It is generally accepted that for each new direct employment opportunity added in a community there will also be an increase of one employee in commercial service activities in the community. In an isolated, rapid-growth community such as Fort Simpson this service multiplier could be somewhat higher, but a conservative value of 1.00 has been used. Likewise, the presence of temporary construction workers in the area would increase the demand for certain goods and services, but because the amount is uncertain no allowance has been made for this factor.

C. Projections

The extension of the Mackenzie Highway north to the Mackenzie Delta and the Arctic Coast is already underway, and all indications are that the highway will be completed to its northern terminus by 1980. Thus, the growth of Fort Simpson attributable to the highway extension appears

to be a virtual certainty. Construction of the proposed Mackenzie Valley Gas Pipeline is by no means as certain, nor is the date of its resultant impact on the population of Fort Simpson. Therefore, the following tabulations show,

firstly, the predicted population increase if the pipeline is not constructed;

secondly, the predicted population increase directly related to the pipeline, assuming a beginning of logistical work in 1976 and commencement of construction in 1977; and

thirdly, the combined population increase including that due to pipeline construction on the above schedule.

1. Population Increase without Gas Pipeline

Item	Year						
	1974	1975	1976	1977	1978	1979	1980
Permanent Population:							
Highway Maintenance		20	20	20	20	20	20
Highway Commercial and Service		25	50	60	70	80	90
Truck Service		10	15	20	25	25	25
Construction Service		25	50	75	75	75	75
Government	18	32	39	58	73	88	103
High School							60
Institutional	20	40	60	80	80	80	80
Commercial Service	37	148	231	312	342	367	452
Sub-Total	75	300	465	625	685	735	905
Temporary Population:							
Highway Construction	175	175	175				
Sub-Total	175	175	175				
Total Population Increase	250	475	640	625	685	735	905

2. Population Increase Caused by Gas Pipeline

Item	Year				
	1976	1977	1978	1979	1980
Permanent Population:					
Highway Commercial and Service		15	30	20	10
Truck Service	5	10	15	15	15
Pipeline O & M				100	175
Construction Service		25	75	125	125
Government	7	26	39	52	58
High School			60	110	100
Commercial Service	13	74	221	423	482
Sub-Total	25	150	440	845	965
Temporary Population:					
Pipeline Construction	50	200	250	200	100
Sub-Total	50	200	250	200	100
Total Population Increase	75	350	690	1,045	1,065

3. Population Increase Caused by Gas Pipeline and Highway Construction

Item	Year						
	1974	1975	1976	1977	1978	1979	1980
Permanent Population:							
Highway Maintenance		20	20	20	20	20	20
Highway Commercial and Service		25	50	75	100	100	100
Truck Service		10	20	30	40	40	40
Pipeline O & M						100	175
Construction Service		25	50	100	150	200	200
Government	18	32	46	84	112	140	161
High School					60	110	160
Institutional	20	40	60	80	80	80	80
Commercial Service	37	148	244	386	563	790	934
Sub-Total	75	300	490	775	1,125	1,580	1,870
Temporary Population:							
Highway Construction	175	175	175				
Pipeline Construction			50	200	250	200	100
Sub-Total	175	175	225	200	250	200	100
Total Population Increase	250	475	715	975	1,375	1,780	1,970

To allow for the uncertainty of gas pipeline construction, the following tabulation shows the projected population of Fort Simpson both with and without the effect of the pipeline.

4. Population Projections, 1973 - 1980

Year	Population	
	Without Gas Pipeline	With Gas Pipeline
1973	1,285	1,285
1974	1,535	1,535
1975	1,760	1,760
1976	1,925	2,000
1977	1,910	2,260
1978	1,970	2,660
1979	2,020	3,065
1980	2,190	3,255

There are other potential growth factors not accounted for in the above projections. It has been previously shown that development of a forest products industry in the vicinity of Fort Simpson is a distinct possibility, and that it would have a marked effect on population. Likewise, considerable growth could result from agriculture and from development of a barge terminal at Fort Simpson. Because growth in these sectors does not appear imminent at this time, they are not considered pertinent to current community planning. However, should future activity in any of these industries develop, they must then be evaluated fully as to their impact on the community.

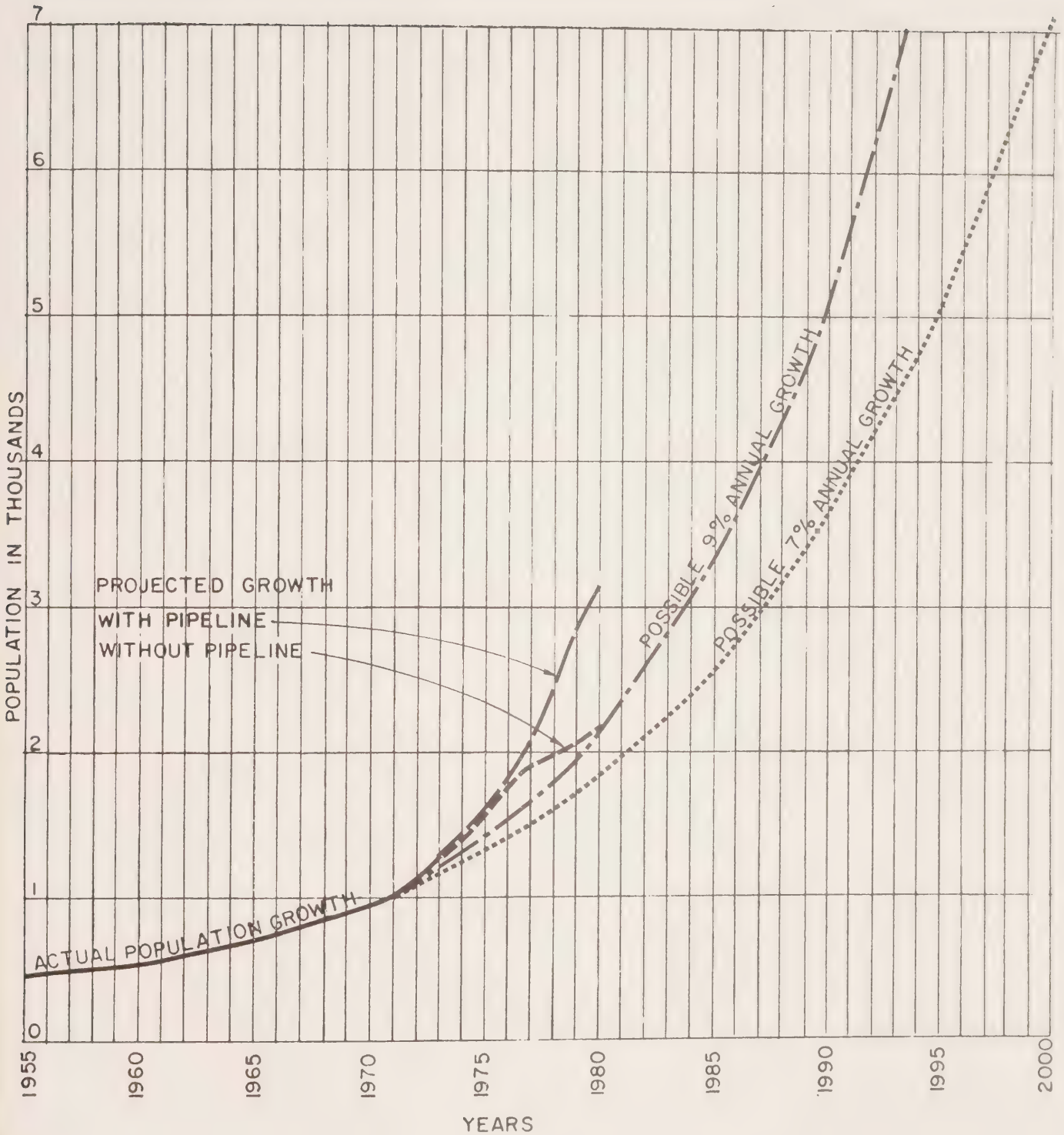
As previously discussed, construction of the proposed gas pipeline would have little effect on the growth of Fort Simpson for the next three to four years and, therefore, does not affect the immediate planning for townsite expansion. Planning for the period 1977 - 1980 would, however, be considerably affected if construction of the pipeline should be seriously delayed.

The following chart shows graphically the actual population growth from 1956 to the present, and the projected growth to 1980 both with and without the gas pipeline. Also shown on this chart are curves of possible annual growth rates of nine per cent and seven per cent, respectively, based on the 1971 population of 1,000 persons.

The nine per cent curve shows the average growth rate that would be equivalent to the projected growth without the pipeline. If this rate continued, the population of Fort Simpson would reach 3,000 in 1984 and 7,000 in 1994. It may be noted that a population of approximately 3,000 is projected for 1980 with the pipeline, and that a population of approximately 7,000 would fully utilize the proposed residential expansion area described in this report.

Since a nine percent growth rate is not likely to be sustained over a twenty year period, a more conservative estimate of continued long term growth is that shown by the seven per cent curve. At this rate, population would reach 3,000 in 1988, and 7,000 in the year 2000.

FORT SIMPSON - POPULATION



V. TOWNSITE EXPANSION ON FORT SIMPSON ISLAND

Available land for expansion on the island is extremely limited. A survey was conducted by Mr. J. E. Clark, M.T.P.I.C., of Clark, Swanby, and Associates Ltd., in October, 1972. His findings as of that time are presented here, together with his recommendations:

> "A certain degree of crystal ball gazing might be expected when contemplating the future of an existing and viable community such as Fort Simpson, particularly when a new townsite is now seriously contemplated. All new developments within the present townsite or on the mainland must simply be considered as an expansion to the present townsite. It has been well proven in other communities up and down the Mackenzie that old towns cannot be replaced even with all the conveniences a new town may boast, consequently, old towns have not died or been replaced - they continue to live and in most cases have even expanded.
>
> The native population and old timers have pretty well remained in the old portions of the town while the newcomers and government sponsored projects have gone to the new site. This is just an observation and not intended as criticism, however, the same type of expansion might be expected for Fort Simpson. Therefore, no mass migration from the island to the mainland can be expected simply because a new subdivision is created on the mainland. The burning questions then are:
>
> 1) What role will the island play in any future development?
> 2) What type of development should be encouraged for future growth of the island?

3) How much development should be allowed?

4) When should development start on the mainland?

In answer, the first question requires a look at Fort Simpson's present role in the region.

a) It is an administrative centre for the Territorial Government, and, to some extent, the Federal Government.

b) It is an educational centre for the region.

c) It is a service centre offering limited services and goods.

d) It is a distribution centre because of barging and airport facilities and the new highway is now making some difference.

e) It is a medical centre offering limited medical treatment.

f) It is a social centre offering limited recreation and religious services.

These roles will continue and expand and there seems to be little reason why they should not continue to the point where there is no room left on the island for them.

However, I believe the island should concentrate on becoming the Commercial, Social and Cultural centre for any future developments. The various Government offices, hospital and schools will remain, in fact, a high school and a technical school should be considered for this centre. I believe Fort Simpson will become a trans-shipment area, particularly with the upgrading of the airport runways, a highway from Fort Nelson and the new Mackenzie Highway plus increased barging facilities. Compared to Hay River facilities, it is not unusual for the rivers to be

open a month earlier at Fort Simpson. Fort Simpson's destiny appears to lie with its transportation facilities and network.

The obvious growth that is taking place and the expected growth leads us to look at the island in terms of how many more people will it accommodate. There are the following vacant areas that could be developed as of December 8th, 1972.

1) In Block 19, it is estimated there are 27 single family lots that could be developed. This is leaving a 200 foot strip vacant next to Main Street. 27
2) Blocks 14 and 15 have approximately room for 12 lots. This would be an infilling process. 12
3) The north Mackenzie subdivision has 11 lots available. 11
4) In the old Agricultural Farm there is just over 11 acres that could be developed. Using a figure of 3.5 lots per acre gives 39
5) The Anglican subdivision has 14 lots available. 14

Total 103

Therefore, using a figure of 3.4/family, an estimated 103 x 3.4 = 350 persons could be accommodated in available lands and in single family residences.

There has been an application for a number of apartments to be constructed on Block 19.

2 - 23 suite apartments - 46 suites.

2 - 36 suite apartments - 72 suites.

Therefore, a projected 118 suites or, assuming a figure of 2.5/suite = 295 persons.

Using this new figure for Block 19 and leaving the remainder as single family would give:

1)	Block 19 - 118 suites x 2.5/suite	295
2)	Blocks 14 & 15 - 12 lots x 3.5/lot	72
3)	North Mackenzie Subdivision - 11 lots x 3.5/lot	39
4)	Agricultural farm - 39 x 3.5/lot	136
5)	The Anglican Subdivision	49
	Total	591 persons

Obviously the density can be altered simply by deciding to put in apartments. There is some merit in considering apartments or even town housing for the island. With increased school room and hospital services and the new federal building, extra staff will be required, and, as there is still a number of single family sites available, some apartments could be in order. The present density in the developed areas is considerably less than the above figures."

Mr. Clark's evaluation indicated that there was room for an additional 591 persons on Fort Simpson island as of late 1972. Since that time, the Agricultural Farm has been subdivided into 50 lots rather than the 39 estimated, and all except a few of these lots have been committed for development. There is an apartment building of approximately 50 suites under construction in Block 19, and there are 12 Government-financed houses under construction on the island. Many lots have also been occupied by or committed for the construction of private homes or installation of mobile homes. In total, as reported by Village officials, there are no more than 12 residential lots, and no commercial lots, now available on the island.

With the growth of population predicted in the previous Section, it is apparent that a start on mainland development must be made in 1974 to permit expansion onto the mainland for occupancy in 1975.

VI. ADDITIONAL LAND REQUIREMENTS AND SITES

A. Land Requirements

1) Land for Industrial Expansion:

It is expected that construction service industry will require an additional 10 to 15 sites of an average 10 acre size before 1977. These sites would be ideally located on the highway adjacent to the existing industrial subdivision. Location on this road will provide convenience to the users and operators of this type of industry, and as there is excellent potential for these industries to continue after the main construction era, sites close to town are desirable.

Land for pipeline construction yard purposes will most ideally be located well south of the townsite. A pipe yard should be accessible to water and road transportation and should be selected for a possible conversion to a log storage and sawmill yard in the future. It is recommended that a 50 acre site be set aside provisionally for this purpose adjacent to the ferry crossing of the Liard. This site should only be leased, unless long-term operations can be proven by the pipeline concern.

Campsites for construction of the pipeline will fall along the pipeline route outside of the immediate Fort Simpson area. However, a new campsite to accommodate highway workers and equipment is a possible requirement by 1975 or sooner. This site, if needed, should be located on the new highway west of possible residential sites to avoid creation of a large, abandoned, cleared area within the townsite area.

Conversion of this site to sanitary land fill in the future could prove an advantage to the town and for this purpose a site screened from the new highway would be advantageous. A location at least two miles beyond any planned development would permit this ultimate use. Temporary campsites do not require piped sewer and water services, nor is a power utility connection a necessity, although desirable. This site, too, should be leased rather than sold as its function is short-term.

Some provision should be made for transportation. industry sites. Possible development of a barge terminus would require a large site, to provide storage for off-season cargo and space for beaching of barges and tugs. The site applied for by Kaps Transport Ltd. on the east side of the Liard is well located, because it provides road access from the south in the period of breakup of the Liard. Thus material can be stockpiled immediately prior to Mackenzie breakup for earliest possible shipping north. It is recommended that one more barging site be reserved on the same side, at least until pipe shipping methods and carriers are determined.

An area should be reserved for a possible trucking terminal or similar operation. This site would be best located so as to avoid unnecessary truck traffic in or near populated areas. A location off the main highway would eliminate potentially hazardous truck turning movements in higher speed zones. A twenty acre site on the highway link to the island and near other industrial development would fulfill these

requirements, and provide short hauls to the airport barge sites and other warehousing. A truck freight centre should be considered a permanent type of "industry" for purposes of location and land negotiation.

A sawmill site would logically be located far enough from town to negate any nuisance from sawdust burners and night noises. A site accessible from the Laird River and from the highway would likely be necessary, and location upstream from the ferry would reduce navigation hazards from floating logs. As discussed previously, a mill site superceding a pipe storage yard would be most opportune if timing permitted. It is recommended that no provision other than this be made, as an alternative site should be beyond the townsite development area in any event.

Agriculture reserves should be established on the sites suitable for gardening immediately. The two areas on the west side of the Liard and the large island in the Liard south of the airport should be preserved indefinitely for this purpose as other suitable land in the Territories is extremely scarce.

The areas recommended for industrial expansion are indicated on the Regional Plan, Plate 1.

2) Land for Residential Expansion:

Additional land is required on the mainland for residential use in four categories:

a) A residential housing area for site-built and prefabricated houses, and multiple units.

b) A subdivision for mobile homes where serviced lots can be purchased, permitting low-cost financing of these units.

c) A mobile home park, offering full municipal services to temporary mobile home population on rented space.

d) A transient trailer park, with temporary, low-cost services which could be abandoned after the highway and pipeline construction phase. This park would offer accommodation to construction workers and other short-term residents in trailers, and could possibly be continued as a tourist facility in season.

The combined area required for permanent and mobile home housing will be related to the number of permanent residents. The previous projections of population growth produce a requirement for new housing space on the mainland, based on an average of 3.5 persons per household, generally as follows:

Year	New Lots
1974	None (space available on island)
1975	65
1976	50 to 70
1977	None to 75
1978	15 to 115
1979	15 to 115
1980	50 to 55
Total	195 to 495

These figures reflect the range of growth rates which would be dependent upon construction of the proposed gas pipeline. This factor is expected to begin to influence community growth in 1976, and to have considerably greater effect in 1977 and subsequent years. It is shown above that there will be a requirement for 65 developed and serviced lots in 1975, 70 in 1976, 75 in 1977, 115 in 1978, 115 in 1979, and 55 in 1980.

As discussed elsewhere in this report, modern mobile homes have many advantages, particularly in the north and for residents whose employment may be of a temporary nature. It is assumed that sixty per cent of the newcomers to Fort Simpson will prefer this form of dwelling, at least initially. For a number of reasons, including cheaper long-term financing and the intention to build permanent homes in the future, it is further assumed that one-fourth of these will prefer to place their mobile homes on purchased lots in the mobile home subdivision. Of the forty per cent of new residents who are expected to prefer permanent dwellings, it can be assumed that some portion, say one-fourth, will prefer apartments rather than single-family houses. On the above basis, the requirements for the various types of residential lots or spaces may be projected as follows:

Year	Residential Space Requirements				
	Total	Apartments	Single-Family Subdivision	Mobile Home Subdivision	Mobile Home Park
1975	65				65
1976	70				70
1977	75		25	50	
1978	115	25			90
1979	115	25	65	25	
1980	55		55		
Total	495	50	145	75	225

3) Land for Other Expansion:

Areas will be required for future commercial, transportation and civic purposes; for schools, parks and open space; for highway commercial facilities; and for associated warehousing and storage areas. Location of these facilities will be interrelated with the residential expansion areas, and will be discussed in the following Section.

B. Expansion Site Selection:

Three sites were considered and investigated for possible residential expansion of Fort Simpson. Each was examined on aerial photos, by site inspection on the ground, and by soil testing. The three sites are shown on Plate No. 2. Results of the soil tests, performed by E. W. Brooker and Associates Ltd., are contained in Appendix "A".

1) Selected Site:

The site selected as most favourable for development for residential expansion is located at the top

of the high hill across the snye from Fort Simpson island. This site was recommended to, and adopted by, the Fort Simpson Village Council on January 10th, 1973.

The site extends from a large spring beside the ski hill opposite the town airstrip to a point northwesterly beyond the tip of the island, and south to the new highway. A second large spring in the bank of the snye is located opposite the new Tel-Sat tower on the north end of the island.

The site is heavily wooded with spruce, poplar and birch. Undergrowth is light to moderate. Surface drainage is generally good, with a slope towards the snye. Subsoil consists of sand, becoming wetter with depths but not so wet as in the second (south) alternative site examined. Towards the northerly end of the area examined, a layer of silt, some free water at a depth of thirteen feet, and some permafrost was found. Therefore, the area between the two springs and north to a line a short way beyond the tip of the island is the prime part of the total site examined, in terms of subsurface conditions.

The site was examined by Pemcan Services in their Granular Materials Inventory as part of their "Site No. FS 3". They reported the material to be fine sand suitable for marginal general fill requirements. This site is also wooded, with spruce, poplar and some birch. The two spring outlets are in"alcoves" in the top of the snye bank, with ravines carrying the spring water down to the snye.

The natural beauty of these springs is striking with tall slender spruce trees, reaching almost a hundred feet up to share the sun with treetops on the higher levels. The balance of the area is moderately undulating, but this presents no serious drawback to development.

To better evaluate the site, and to facilitate the development of a conceptual plan for expansion in this area, a large scale contour map was prepared from available aerial photography. This map could be expanded in coverage to form the basis for more detailed planning and design. Because of its large size, copies of the present map will be furnished under separate cover.

The only serious disadvantage of this site is access from the present island development. A round-about route across the existing causeway, back along the new highway and north again to the site would mean about seven miles travel between the new site and "downtown". However, a second causeway across the snye from the island could be built which would bring the new subdivision area to within a mile of the existing community. A new causeway could be used to create a new lake in the snye, suitable for floatplane operations or recreational use. Fresh water from the springs would reduce the hazard of stagnation in this closed body of water. Drainage pipes with control gates through the new causeway should be used to control the water level (limited to a degree by porous soils).

A new causeway could also be built in such a fashion that it would form a dyke to prevent annual spring flooding of the low lying land on the island.

Subsurface water conditions in this portion of the island might well make underground utility work impractical, but use of the area for other than normal housing development is also possible.

2) Alternative Sites Considered:

a) The first alternative site considered is located on the mainland immediately across the existing causeway and west of the present highway. This site is moderately undulating but poorly drained. Subsoil is wet sand over silt and clay at depths of five to sixteen feet. In addition to excess moisture, permafrost was encountered at depths of three feet in the east end, to about nine feet generally and twenty-four feet as far east as the ski hill.

This site was judged to be unsuitable for development requiring buried utilities, because of the permafrost encountered. Relatively high ice-moisture contents in silt formations would cause settlement of roads, pipes and foundations, as the permafrost thawed. Thawing would occur with clearing, development and trenching for utilities.

b) The second alternative site examined was on the highway south, beginning at four-mile road and extending towards the airport, also known as the C.M.H.C. Site. Surface drainage was found to be generally good in this area, and no frost was encountered. Subsoil proved to be sand, over clay at depths of 12 to 17 feet. Free water was encountered on the

bottom of the sand layer, over the clay. It is assumed that this free water is the source of excellent well water found in the industrial subdivision to the north. Water from a well at Turner Expediting Co. was tested, and found to be suitable for domestic use with no treatment.

The site is wooded, with poplar, spruce and birch. Organic cover is shallow, and the site is generally well-drained, with some localized wet areas. The area slopes generally towards the Liard, to the southeast.

This site was judged to be superior to the first alternative described. The absence of permafrost would be a significant advantage for foundations and shallow pipe installations. However, the free water at depths of about ten feet would make installation of normal sewer and water mains somewhat difficult and expensive.

The presence of this water would almost guarantee that shallow wells could supply domestic requirements, at a minimal cost of installation. The sand subsoil would make construction of roads easy and cheap, and the slope of the site would facilitate surface drainage. The tree cover in this area creates an extremely attractive surrounding. However, the difficulty of installing underground pipes is a distinct disadvantage as is the distance from the island community.

The site could likely be developed as a residential subdivision, using wells for a water supply. However, sewage would have to be collected and treated in a lagoon, or pumped to the island site for treatment,

as pollution of the water aquifer would be a definite hazard if cess-pits or septic fields were used in such a heavy concentration. A lagoon, discharging to the Liard (upstream from town) would be more expensive ultimately than a pumping station and forcemain to the island.

If wells were to be used for water supply, some means of storing large quantities of water would be necessary for fire-fighting. The question of the adequacy of the underground reservoir to support a large residential subdivision could only be settled by drilling test wells and performing pumping tests to permit evaluation of the aquifer. Indications are that such a supply could be present and easily available, but if supply did not prove adequate, a watermain connection from the island would be required.

The most important drawback to this site is the four mile separation from the present island townsite. Apart from the travel distance involved, development of this site as a residential subdivision would create a distinct, second community. This division should be avoided, if possible, in the interests of community spirit and consolidation of recreational and social services. Thus, while the area is physically well suited to location of mobile homes, it is not recommended that the permanent mobile home park, or the housing and mobile home subdivision be located here. However, this second site would be very suitable for use as a trailer court, designed primarily for transient residents in trailers and

campers. This facility could also serve the tourist traffic which is anticipated to build as the highway progresses. A possible road link to the new national park in the Nahanni would help to assure the continuing profitable operation of a trailer court for the tourist trade, on an attractive part-year operational basis. In addition to a transient trailer court, the site offers definite advantages for expansion of light industry. The site is close to the airport and ferry, and just beyond the highway junction. Water is available for light use, and the concentration of sewage resulting from possible use of leaching pits would not likely create pollution of the water aquifer in an industrial development pattern where such pits would be widely separated.

VII. PROPOSED EXPANSION PLAN

A. Introduction

The purpose is to plan an area of land for future expansion of Fort Simpson. The site selected, as described in the preceding Section, is located on the mainland immediately across the snye from the present Village site on Fort Simpson island and is shown on the Regional Plan and on Plate 3.

B. The Concept

The principle is to have an accepted plan that the general public, the Council of Fort Simpson and the Territorial government can use for any future development. The basic use of the land would be for residential use with a variety of housing to be offered. Areas for mobile homes, town housing, apartments, duplexes and single-family dwellings would be established. Implementation can then proceed within a designed framework. It is the intention of the conceptual plan to provide means by which coordinated development may be set out. This will provide individual developers, the Village and other interested parties with a clear indication of the requirements before proceeding with the preparation of more detailed proposals.

C. Objectives

1) To achieve a rational pattern of land use.
2) To outline an efficient, safe and attractive circulation network for vehicles and pedestrians alike.
3) To provide the area with a desirable range of public facilities, amenities and services in balance with the proposed density.

4) To develop strong open space orientation for environmental, recreational and aesthetic purposes.

In general terms, the objective is to promote a form of development in the public interest for safety, health, economy, convenience and aesthetics.

D. Land Use

1) Town Housing and Apartments:

The principal idea is to place high density town housing and apartment sites in the immediate vicinity of the town centre. This places the greater number of people next to the greatest concentration of facilities, within reasonable walking distance (one-fourth of a mile). This will provide a choice of housing styles and some new innovations in mobile modular homes or prefabricated housing may emerge.

2) Residential Subdivision and Mobile Home Subdivision:

Selected areas have been established in the conceptual plan, shown on Plate 3, for people who wish to own their own homes. It is felt that lots should range in size to suit a variety of tastes. Conventional lot sizes of sixty feet by one hundred and twenty feet plus some larger frontage lots should be provided. As mentioned in the Town Housing and Apartment section, housing of the future, and particularly for the north, will probably appear in prefabricated packages and mobile modulars.

The housing subdivision and mobile home subdivision should be of comparable quality. Lot sizes and layout in the mobile home subdivision should permit conversion to other forms of housing (at the option of the owners),

and buried services should be installed at depths permitting conversion. A combined subdivision would permit flexibility for the Village, with mobile homes restricted to one portion of the subdivision. As the two types of housing expanded, they would meet at whatever boundary demands created, avoiding unnecessary reservation of "untouchable" lots for either mobile homes or permanent housing.

Due to the limited capacity of the house-building industry in Fort Simpson and the anticipated preference for mobile home living during the growth of Fort Simpson, expansion will almost certainly create the largest demands for space in the mobile home subdivision and in a permanent mobile home. The division of the demand between these two is speculative at this point; factors favoring the mobile home subdivision include the following:

a) C.M.H.C. financing is available for new mobile homes on resident-owned lots provided permanent foundations are installed. A saving of up to $1,000 in interest annually can thus be applied to purchase of a lot. A definite attraction to the mobile home subdivision is thus created for permanent mobile home residents.

b) Some permanent residents of Fort Simpson in mobile homes will likely view purchase of a mobile home subdivision lot as a bearable first step to ultimate house ownership, on their mobile home lot or elsewhere through sale or trade of their lot equity.

3) Permanent Mobile Home Park:

A mobile home park is required at Fort Simpson to provide for the following:

a) Permanent residents who choose mobile homes as their housing, for purposes of economy, site maintenance ease, workmanship and amenities now built into mobile homes.

b) Residents who start out in mobile homes, for purposes of initial economy or to delay the committment involved in a house purchase or purchase of a mobile home subdivision lot.

c) Residents who will be located in Fort Simpson for a specific length of time during construction of the pipeline or other specific projects.

d) Residents subject to transfer, or relocation by choice, including teachers, government personnel and employees of large firms such as the Bay, P.W.A. or N.C.P.C.

Mobile home parks should have about 200 stalls to be operated efficiently. Therefore, a trailer park area large enough for 200 units is planned, and a similar area is reserved for a second park, as shown on Plate 4. An alternative layout is shown on Plate 5.

The mobile home parks should be serviced fully with sewer, water, power, telephone, playgrounds, and adequate roads. To accomplish sewer and water servicing at reasonable cost, and to avoid splitting the community unduly, the parks would be located adjacent to the residential area.

The operation of a mobile home park under the conditions anticipated at Fort Simpson should permit private enterprise to develop and service the initial park. No attempt should be made to create lots suitable for conversion to residential development, to the detriment of an economical mobile home lot layout. It is proposed that lots be a minimum of forty feet wide and 100 feet long, with wider lots available for "double-wides".

Off street parking for at least two vehicles per unit is necessary, and playgrounds are required in enough locations to be readily accessible to all units. Roads should be at least thirty-two feet wide, and all-weather sidewalks are required throughout. A service contract is required for provision of municipal services and a comprehensive resident's code must be instituted and enforced for maintenance of units, if the park is to remain attractive. The service contract should consider trailer license revenues in conjunction with servicing costs to ensure that trailer residents are neither subsidized nor penalized by the other village residents through the local government charges.

The operator of the first park should be offered a franchise protecting him to a certain occupancy, subject to proper operation at rates approved by Council. He should also be granted full rights to the land occupied to balance a relatively large investment. Under these conditions, it is anticipated that no difficulty will be encountered in

attracting a park developer, and holding him to development of an attractive park.

Clearing of trees should be strictly planned and controlled. The low, uniform profiles of mobile homes can create a village of boxes in a totally cleared area, and the privacy of residents on small lots can only be preserved by leaving screenings of mature trees between the stalls.

In early 1973 consideration was given by the Council of the Village of Fort Simpson to a call for proposals from private individuals for the development of the first phase of the mobile home park. The information for prospective developers and the general design standards prepared at that time are presented in Appendix "B" for reference.

4) Transient Trailer Park:

The temporary trailer park would be located adjacent to the north side of "Four Mile Road", as shown on Plates 6 and 7. The park would be located 500 feet east of the highway to minimize dust nuisance and to be screened from the highway and would be developed as a series of trailer clusters, as shown on Plate 8, with a separation from the existing road. Each cluster could then be serviced with a separate well and a separate small sewage pump-out tank. The number of units in a cluster should be between six and twelve, depending upon the capacity of the individual wells. A sewage holding tank would require capacity for about 100 gallons per day per trailer.

The land should be leased to a private operator, on a three-year lease only. This period would permit the recovery of servicing costs estimated to be in the order of $1,000 per unit, payment of a reasonable lease fee, and an appropriate operating margin for an operator over this period of time. An agreement should be entered into between the Village and the operator, prior to grant of a lease, covering operation of the park. This agreement should lay out acceptable standards for trailers and of park operation, terms of sewage disposal to the Village sewer system, responsibility for telephone and power utility service charges, maintenance of access, arrangements for police patrol and terms of garbage disposal to the Village disposal area. The agreement should also fix the rental rate as the lease is equivalent to a franchise.

It is recommended that the Village arrange for sewage pickup and disposal of the sewage by dumping into a manhole on Mackenzie Drive near the outfall. This could be done by Village forces or by supervised subcontract. Use of septic fields or leaching pits should not be permitted if wells are to be used for water supply, because of a danger of contamination. Also, the water aquifer appears to be common to all wells on the mainland and should therefore be protected.

5) Schools:

Two elementary school sites are centrally located, one within each of the two main housing areas. The principle is that children will not have more than one-quarter to one-half mile to walk to school.

A high school site has also been set aside. This provision is a simple safeguard to provide space for an anticipated high school and perhaps a vocational school. In all likelihood Fort Simpson will grow as an education centre serving the region. Although the island may be the logical spot to expand the educational centre, there is little room left for a development of this magnitude.

6) The Community Centre:

The Community Centre is an area set aside for future commercial, transportation and civic use. The concept is to have a commercial core adjacent to a central park backed by higher density uses such as apartments and town housing complexes. Within the commercial core would be an enclosed pedestrian mall housing the usual commercial outlets. There would also be a transport centre containing a bus station, taxi stands and air service offices. A civic square containing community and administrative services might be considered. It should be noted that such a centre does much to enhance the community as a desirable place to live.

The basic idea of the town centre design is to create vehicular and pedestrian segregation. The centre is served by a collector loop road from which local cul-de-sac roads penetrate to parking and service areas. This system will allow a minimum degree of conflict between pedestrian and vehicular traffic. One other system that might be considered is a loop service road. This will provide through

vehicular traffic but sacrifice some degree of segregation with pedestrians.

7) Highway Commercial:

Two nodes have been shown on the conceptual plan and as indicated may grow together as the demand requires. Facilities that are basically used by the travelling public will be located here, such as gas and service stations, a truck servicing centre for maintenance and repair and restaurants and motels.

8) Wholesale, Warehousing and Storage:

The area has been set aside to serve and complement the highway commercial strip and the shopping complex in the town centre. There is no purpose, at this time, in developing this area until a demand has been created by the nearby commercial complex but it is important to remember that by locating this area immediately adjacent to the highway, as with the highway commercial strip, undesirable heavy truck traffic will generally be diverted from the immediate vicinity of the town centre. This area will be put into a holding zone until needed for this specific purpose.

E. Landscaping

Although landscaping, in the traditional sense of the work (i.e. new planting and transplanting) may be carried out in conjunction with each successive stage in the development of the new expansion site, it will be much longer, in view of the high latitude and the slow growth

rate, before the desired effect is achieved. Even careful layout in a typical northern community, where trees and plants are lacking, can produce a bleak and uninviting result. Therefore, it is suggested that landscaping include the careful creation of enclosures with artificial screens and walling to provide continuity in visual design, until such time as planting and transplanting take full effect.

F. Open Space

Great amounts of open space have been provided within the plan. Particular attention is focused upon the two main gullies, as the most southerly gully would be used as a source of water supply. Both gullies must be protected from any encroachment and be left in their natural state. In this respect, it is suggested that no development take place within 200 feet from the top of the escarpment. The hillside down to the snye must also be protected; however, selective tree cutting for pedestrian paths and snowmobiles might be provided as well as some clearing for toboggan and ski runs.

G. Parks

Parks for passive and recreational use must be provided in each subdivision, along with small tot lot parks for youngsters. The civic park is the main park feature within the total complex and it is anticipated that this would be an area to bring people together for ball games, hockey games, curling, etc. The development of a park of this nature might be undertaken by the Chamber of Commerce or service clubs.

H. Roads

A network of roads to serve the various subdivisions is proposed. This network of roads will vary in width to provide safety and convenience. Sidewalks may not be built for some time and as there will be little or no snow removal extra widths are justified.

I. Industrial and Storage Sites

An extension to the present storage sites on top of the hill on the mainland is contemplated at this time, and an outline plan for this extension plus a waterfront subdivision all within the one subdivision is shown on Plate 9.

The subdivision has been designed on the basis of good ground conditions and accessibility, as derived from aerial photo interpretation, and is in the vicinity of the existing industrial subdivision. It is felt that the existing ten acre parcel sites were too large as they have been divided into smaller sites; consequently, the present design employs mainly two acre parcels and slightly larger.

One other area that can be considered for industrial and warehouse storage sites is the area lying between the intersection in the roads between the Fort Simpson and the Mackenzie Highways, as shown on Plate 10 . This particular area encompasses the present D.P.W. site and considerable additional lands. Again, approximately two acre parcels have been designed; however, these can easily be made larger if necessary. It is assumed that this area will be serviced with power only.

VIII. UTILITIES - EXISTING CONDITIONS

A. Water System

1) Mackenzie River Supply:

Until the spring of 1973, Fort Simpson's water supply was provided entirely by a treatment plant located on the bank of the Mackenzie River. Water is drawn from two intake pipes extending into the river. The original length of these pipes has been reduced by ice damage, and the water drawn during the open-water season is that of the sediment-laden Liard River. The Liard enters the Mackenzie immediately upstream from Fort Simpson and its flow is concentrated along the south bank adjacent to the village. The two flows can easily be seen in the Mackenzie, with relatively clear water evident on the far side from Fort Simpson.

The intake pipes are connected to a pump well on the river bank, the top of which is well below the high water level of the river. A portable submersible pump in the pump well lifts the water to the treatment plant. Two such pumps are available, with capacities of 150 and 170 USGPM, although only one is used at a time. Considerable trouble has been experienced with silt deposition in the pump well and it has sometimes been necessary to install a portable engine-powered pump to draw water directly from the river. This expedient could also be necessary in spring when the pump well is submerged by the river for several weeks, should the submersible pump fail to operate.

The treatment plant, installed in 1959, is well designed and laid out, though undersized under recent loads. Maintenance is excellent and operation is a credit to the operator, requiring constant testing of raw and treated water with frequent adjustments necessary to maintain quality. The plant consists of a Cochrane solids-contact reactor - clarifier, gravity (carbon) filter, chemical feeders and a 120,000 U.S. gallon storage reservoir. The water is chlorinated prior to entering the filter and is fluoridated prior to distribution.

Two service pumps rated at 75 USGPM each charge the water distribution system, and two 25 USGPM circulating pumps draw water back to the plant to prevent chilling in the mains. Two fire pumps rated at 500 USGPM each are powered by 50 h.p. General Motors diesels. All pumps are Fairbanks Morse.

Although design capacity of the treatment plant is 75 US gallons per minute, output of the plant has recently averaged 100 to 110 USGPM, with peaks of 125 USGPM plus. Total solids in the raw water approach 1,500 parts per million throughout the summer, with values in excess of this in spring when the silt load of the Liard increases, making treatment difficult and restricting the capacity of the treatment plant. As demand for water fluctuates to as much as 200 US gallons per minute, it is no longer possible to maintain a constant reserve in the reservoir for fire protection, nor to meet some of the domestic demand peaks.

2) Mainland Spring Supply:

Because the capacity of the water treatment plant to treat river water was severely overtaxed during the summer of 1972, it became apparent that an alternative source of supply was necessary. Accordingly, it was decided to develop natural springs on the mainland as a possible long term raw water supply. The results of water testing analyses made at that time are included in Appendix "C".

In March, 1973 an earthfill dam was constructed immediately downstream from the location of the springs. A six-foot diameter corrugated metal culvert pipe intake well was set vertically above the dam to collect the spring water, and a six-inch yellow-jacketed welded steel pipeline was installed to carry the water to the island treatment plant. Funds for this project were limited, and because the quantity of flow available from the springs had not been tested in winter, it was decided to lay the pipeline on the surface initially, except across the snye, and to dispense with any insulation or provisions for anti-corrosive lining. During construction, it was decided to bury the portion of the line on the island at a shallow depth for protection from traffic damage.

The dam and pipeline were completed and the spring water supply was put into operation on April 18th, 1973. It was found to have a capacity of approximately 160 USGPM initially, increasing to at least 200 USGPM during the following summer.

When first used, the spring water was found to have a very high colour, relatively high turbidity, high hardness and alkalinity, and attempts to treat the water in the existing treatment plant were only partially successful. Modifications of the intake well to exclude surface flow from snow-melt improved water quality, and this source was used throughout the summer of 1973.

It was originally intended that the temporary pipeline would be used only until the adequacy of the spring source had been proven, and that it would then be protected against freezing by insulation or by burying at an adequate depth. The spring water becomes extremely cold in late winter, temperatures as low as 32° F. being recorded in February, 1973. Thus, only the latent heat of fusion would remain to prevent freeze-up, and if the pipeline is used during the winter it would be vulnerable to blockage if flow was interrupted, unless protection is provided.

3) Distribution System:

The distribution system consists of eight-inch and six-inch asbestos cement water mains forming loops and subloops, with a depth of bury of about ten feet. Water is circulated through these loops by pumps at the water treatment plant. Because portions of the mains are located in permafrost it is necessary to operate the circulating pumps throughout the year. Individual building services consist of two copper lines from the main into the building, with each service having its own

small internal circulating pump to maintain flow in the service lines.

B. Sewerage System

The sewage collection system consists of eight-inch asbestos cement sewer pipe with ring-tite joints. Manholes in the original system were constructed from concrete blocks while manholes in subsequent extensions were constructed from precast concrete rings. All manholes have frost protection covers. Depths of sewer mains vary from five to twelve feet. Portions of the original mains were constructed with very flat slopes, and these lines require periodic flushing to maintain flows. Some problems have been experienced with freezing of mains, probably due to flat slopes and shallow cover. Effluent from the system presently is directed untreated into the Mackenzie River at the downstream end of the community.

C. Garbage Disposal

Garbage disposal is presently handled by sanitary landfill at a site at Mile 295 on the Mackenzie Highway.

D. Power

Power for Fort Simpson is supplied by the Northern Canada Power Commission (N.C.P.C.) The powerhouse is comprised of two buildings, one of timber frame construction thirty feet by fifty-eight feet, the other a steel rigid frame forty feet by ninety-six feet. Generation equipment consists of six diesel units, as follows,

Unit # 1 - Ruston Hornsby RHATX6	600 KW
Unit # 2 - Mirrlees TL56	280 KW
Unit # 3 - Caterpillar D343	220 KW
Unit # 4 - Ruston Hornsby RHEE	1,000 KW
Unit # 5 - Caterpillar D399	700 KW
Unit # 6 - Caterpillar D398	500 KW
Total Capacity	3,300 KW

Fuel storage capacity is 317,000 gallons, consisting of three 105,000 gallon and one 2,000 gallon tanks. The plant has an operating staff of seven persons.

IX. UTILITIES - PROPOSED IMPROVEMENTS

A. Water System

The projected population of Fort Simpson of approximately 3,000 persons in 1980 would require a water supply system capable of producing an average flow of about 210 US gallons per minute, and a peak flow of at least 420 USGPM, based on an average demand of 100 USG per capita per day and a peak demand of twice that amount. The water systems of the island community and the proposed mainland expansion area should be fully integrated, though flexible enough to operate independently if necessary.

Experience to date has indicated that the mainland springs will produce a reliable flow of at least 200 USGPM, during the summer months, in their present state of development. It is believed that a more extensive system of underground collection galleries or wells would produce much more water. However, no winter flow tests have yet been made and it is not possible at this time to determine the dependable year-round flow capacity of these springs. Therefore, the proposed improvements described herein are based on the premise that the mainland springs will provide the primary water supply for the total community during approximately eight months per year; and that water will be drawn from the Mackenzie River during the remaining four months, during which time the river will be ice covered and the river water of comparatively good quality. During the detailed planning and design which will precede any water system improvements, a series of flow tests should be conducted to verify the dependable capacity of the springs, and the system designed accordingly.

1) Mackenzie River Supply:

The existing treatment plant cannot be expanded to supply the needs of the expanded community which has been predicted. Some increase in maximum capacity could be achieved by installing a new intake line to a more favourable location in the river where the clearer Mackenzie water could be drawn instead of the turbid Liard water near the bank, thus improving the raw water quality and reducing the amount of sediment to be removed. The installation of additional equipment and revised piping would be required, in a new building. The cost of these additional plant facilities is estimated to be $225,000; a new intake well would cost an estimated $25,000; and a new buried intake line to clearer water in the Mackenzie is estimated to cost $150,000. Thus, upgrading the existing plant to meet anticipated loads would cost approximately $400,000 in total. Furthermore, it is predicted that at least two-thirds of Fort Simpson's ultimate population will be located on the mainland, at an elevation of more than one hundred feet above the level of the river. Reliance on the river for water supply would thus greatly increase the cost of pumping water to the mainland expansion area. Conversely, with the mainland springs providing the primary water supply during the summer months, it should be possible to operate the water system on the island under gravity pressure with no pumping required except for circulation, and much less pumping would be required for the mainland service area.

Therefore, it is proposed that the existing island water treatment plant be modified to serve as an alternative source of water supply during the winter months, to be used only if the mainland spring supply should prove to be inadequate during that period. This would include modification of the intake lines and intake well to increase reliability and avoid siltation problems, increased pumping capacity and revised piping, but would not require a new building. This work is estimated to cost $100,000.

To provide an adequate reserve supply of water for fire-fighting, a minimum storage on the island of 380,000 US gallons is recommended by the Canadian Underwriter's Association. The system should be capable of providing a guaranteed fire flow of 1,260 USGPM for a duration of five hours (for a population of 1,500). A reservoir on the island with a capacity of 500,000 US gallons would provide a suitable fire protection reservoir, and would also provide a reserve for interruption of supply due to pump failure or supply line breakage. The estimated cost of this reservoir is $200,000. Because this reservoir would not be as essential as other required improvements it is proposed that it be constructed near the end of the expansion period.

2) Mainland Spring Supply:

It is proposed that this source be developed as the primary source of water supply for both the existing community on Fort Simpson island and the proposed mainland expansion area.

The first requirement is to convert the existing six-inch temporary pipeline to the island into a permanent supply main. It is proposed that it be protected from freezing by insulation or by burying at an adequate depth, at an estimated cost of $70,000. This work should be done during the summer of 1974. It is also proposed that the steel pipe be protected against internal corrosion by installation of a plastic lining. This work could most economically be done at the same time as the frost protection above, at an estimated cost of $20,000, for a total supply main improvement cost of approximately $90,000.

To develop the springs as an adequate source of water, both for present needs and for future expansion, it will be necessary to install a more extensive system of underground collection galleries or wells. While this work could be done in stages as the demand increases, the later stages of construction would probably interfere with operation of the earlier-built stages and costs would be increased. Therefore, it is proposed that, after completion of a series of flow tests to verify the dependable capacity of the springs, a permanent collection system adequate to meet the ultimate needs of the community be constructed. This facility is estimated to cost $60,000.

A new water treatment and pumping plant will be necessary to serve the mainland expansion area. Treatment would be limited to the removal of iron, a comparatively simple process, plus chlorination, fluoridation, and pH correction. Capacity would be

adequate to meet the demands of the combined community. Piping would be arranged so that the new plant could supply both the mainland and the island during periods when the spring supply was sufficient to meet the full demand, or to supply only the mainland during the winter if this became necessary. Provisions would also be made for river water to be supplied from the island treatment plant to the mainland in emergencies. Fire protection for the mainland community, with a population of 2,000, again as specified by the Canadian Underwriters' Association, would require reserve storage of 540,000 US gallons and fire pumps capable of supplying 1,500 USGPM for six hours. It is proposed that the mainland water treatment plant and reservoir be constructed in close proximity to the springs, at an elevation such that the spring water will flow into the plant by gravity. Since this source will not be subject to short-term interruption, no reserve storage other than that required for fire protection is considered necessary and none is proposed. However, balancing storage will be necessary. The total estimated cost of the mainland water treatment plant and reservoir, to be constructed as an integral unit, is $480,000.

3) Well At Snye:

During construction of the snye crossing for the temporary waterline a gravel horizon was noted in the snye bed. While this may be an isolated pocket it is possible that a gravel layer extends throughout

the length of the snye and carries a groundwater flow from the Mackenzie River. Should this be the case, a well centrally located between the existing and proposed causeways could serve both the island and proposed mainland development.

It is recommended that this possibility be investigated. An initial drilling programme consisting of approximately ten test holes would establish whether or not the suggested gravel layer does exist and if so give an indication of the probable yield and quality. Should these tests be affirmative a pumping test could be carried out at a central location to establish long term capacity. Costs for this investigation are estimated at $5,000 to $10,000 depending on the availability of drilling equipment.

4) Distribution System:

In view of the substantial expansion that has occurred on the island since the original distribution system was installed, there appears to be some question as to the adequacy of the circulation which is necessary to prevent freezing in the mains. Therefore, it is proposed that as part of the design studies for water system improvements a detailed distribution analysis be made so that any necessary corrective measures may be provided. Detailed requirements will be based on block by block testing of the distribution mains for leaks, and will include all measures necessary to bring the island distribution system up to the standard of the new development

area. These measures are estimated to cost approximately $80,000.

The transmission line from the mainland water treatment plant to serve the proposed expansion area would be designed as a loop system to maintain circulation. This line would be necessary before any of the proposed development area could be permanently serviced from the treatment plant, and should be constructed simultaneously with the plant. The transmission line, which would constitute the first increment of the mainland water distribution system, is estimated to cost $100,000. The line would be designed for ultimate extension to serve the entire residential expansion area, including the adjacent institutional and commercial areas, but the cost of these further incremental extensions would be included in the development costs of the individual subdivisions or other developments.

B. Sewerage System

1) Sewage Treatment:

At present sewage is discharged untreated to the Mackenzie River, at the downstream end of the island development. Under conditions of normal growth, treatment should be under consideration now. In view of the rapid growth predicted for Fort Simpson, immediate installation of treatment facilities will be necessary under provisions of the new environmental protection acts. It is most unlikely that plans for townsite expansion, as discussed herein, would be approved by Environment Canada without provision for sewage treatment.

The most satisfactory and economical method of providing sewage treatment in this community would be the construction of aerated sewage lagoons, with a diffused aeration system which would insure successful performance even in sub-zero weather. The proposed treatment system would consist of two separate one and one-half acre lagoons designed to operate in series. Each lagoon would have a 20-day retention time. The waste would flow to the primary lagoon from the mainland expansion area by gravity, but connection of the existing island collection system would require construction of a lift station and forcemain. Overflow manholes would allow each lagoon to operate at a ten-foot depth with continuous discharge to the Mackenzie River. Soil tests indicate that clay and silty clay in the area of the snye are suitable for lagoon construction, and it is proposed that the lagoons be built on the mainland near the downstream end of the snye, as shown on Plate 1. This site would be accessible from both the mainland and the island, and the island force main could cross the snye on the proposed causeway discussed below. It is estimated that the aerated sewage lagoons, complete with aeration system, access road and power supply, would cost approximately $250,000.

2) Collection System:

A main sewage outfall from the mainland expansion area, estimated to cost $60,000, would be necessary before any of the expansion area could be serviced. As previously discussed for the water system, the cost of further extensions would be

included in the development costs of the individual subdivisions or other developments. The sewage lift station and force main to connect the existing island system to the lagoons would cost an estimated $120,000 provided the causeway had previously been constructed.

As discussed in the previous Section, certain portions of the original sewer mains on the island are not in satisfactory condition and an undetermined amount of rehabilitation work should be done to avoid continuing maintenance problems. Further studies will be necessary to accurately assess the requirements, but for programming purposes this rehabilitation is estimated to cost $20,000.

C. Garbage Disposal

Garbage disposal will best continue to be handled by sanitary landfill. When the existing site is filled or abandoned, a new site should be located well outside the development area. Location along the highway route will provide economical all-weather access, and to this end a possible site is proposed at a campsite location northwest of the new development areas. The location of an alternate site would not be difficult, and the initial cost of development would be limited to possible clearing if a sidehill site can be used. Thus, burying of wastes will not require deep trenches.

D. Power

N.C.P.C. plans to expand their Fort Simpson power plant by the addition of one 1,800 KW unit in 1974 and one 1,500 KW unit in 1975. This will allow the removal of existing units 2, 3, 5, and 6 for use elsewhere, leaving

a total capacity of 4,900 KW. They also plan the installation of an additional 350,000 gallon fuel storage tank in 1974.

With the already planned expansion, N.C.P.C. should be able to meet the anticipated growth in power demand for some time to come. Additional expansion through increase in unit sizes or installation of new units should be possible if this becomes necessary. N.C.P.C. has indicated that for reasons of economy in staffing and fuel storage they would not consider installing a second power plant on the mainland, but would serve the expansion area by transmission lines from their existing island plant. Coordination with N.C.P.C. should be continued so that construction of power lines can be scheduled, and to insure that the location of any new lines across the snye does not interfere with possible use of the snye as an operational floatplane base.

E. Causeway and Access Roads

As discussed earlier in connection with the selection of a site for the proposed expansion area, the only serious disadvantage of the proposed site is access from the present island development. To provide ready access between the two areas, it is proposed to construct a new causeway across the snye near the downstream end of the island. With the upgrading of approximately one mile of road on the island and construction of approximately one and one-quarter miles of new road on the mainland, there would thus be provided a second connection between Fort Simpson and the Mackenzie Highway. The causeway would also be used to create a new lake in the snye, suitable for floatplane operations or recreational use. Ministry of Transport standards for floatplane operation require a minimum length of one mile, with no more than a 30 degree bend, and no less than 300-foot width with a minimum

water depth of six feet.

As shown on Plate 1, the new causeway would be in close proximity to the proposed aerated sewage lagoons, would provide access to the lagoon site, and could be used to carry the sewage force main from the island to the lagoons. It is probable that material excavated from the lagoons could be used in construction of the causeway, supplemented by material from the access road on the mainland.

Construction of the causeway is estimated to cost $170,000. Estimated cost of the mainland access road is $75,000, and of upgrading the road on the island, $35,000, for a total estimated cost of approximately $280,000.

F. River Bank Erosion:

There is an area along the Mackenzie River on the northeasterly side of Fort Simpson island, generally between 96th Avenue and 100th Avenue, where the river bank has eroded to the extent that Mackenzie Drive, the street which parallels the bank, is endangered. Continued erosion in this area would threaten the island water treatment plant and other buildings. Erosion appears to be caused by a combination of river current, wind-driven waves and ice movement during spring breakup. It is proposed that a study be made to determine the most feasible means of controlling this erosion, and that appropriate measures be taken to protect the endangered area. Estimated cost of this work, including $10,000 for the study, is $110,000.

X. RECOMMENDED DEVELOPMENT PROGRAM

It is recommended that the proposed development program, essentially as described herein, be accepted and adopted as a guide for the future development of Fort Simpson. This program will provide for the orderly growth and development of the community during the period of expansion which is expected to occur within the next seven years.

It has been shown, through population projections based on reasonable predictions of economic growth, that the population of Fort Simpson may be expected to increase to approximately 3,200 by 1980, and that further growth beyond that point should be anticipated.

The recommended development program will provide space in a permanent mobile home park on the mainland sufficient to accommodate the immediate growth in 1975 and 1976. This park will be created by a private developer under standards to be established by the Village Council. Lots in a combined single-family and mobile home subdivision will be provided beginning in 1977, and provisions for apartments will be made in 1978 and 1979. Planning is included for commercial, institutional and industrial developments as they become necessary. The basic legal surveys, roads, and water and sewer utilities will be provided by the Village as needed to serve the various developments. Improvements will also be provided for the utilities on Fort Simpson island to bring them up to the standard of the new development area.

The schedule of funds requirements to accomplish the recommended development program is contained in the Program Forecast which follows.

XI. PROGRAM FORECAST

DESCRIPTION	PROGRAM, $(000's)						
	Total	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Industrial Areas							
Legal Surveys	16.0	6.0		10.0			
Road Construction	150.0	60.0		90.0			
Residential Expansion Areas							
Contour Map	2.0	2.0					
Engineering Design	60.0		15.0	10.0	20.0	15.0	
Development, Roads & Utilities	(1,040.0)			(300.0)	(50.0)	(440.0)	(250.0)
Mobile Home Park - 65 spaces	None*	None*					
70 spaces	None*		None*				
90 spaces	None*				None*		
Mobile Home Subdivision -							
50 lots	200.0			200.0			
25 lots	100.0					100.0	
Single Family Subdivision -							
25 lots	100.0			100.0			
65 lots	290.0					290.0	
55 lots	250.0						250.0
Apartments - 25 units	50.0				50.0		
25 units	50.0					50.0	
Utilities - Water							
Soiltesting & Investigations	5.0	5.0					
Distribution Study	5.0			5.0			
Engineering Design	50.0	15.0	10.0	10.0	15.0		
Construction	(1,070.0)	(150.0)	(500.0)	(40.0)	(180.0)	(200.0)	
Island Treatment Plant Revisions	100.0				100.0		
Island Reservoir	200.0					200.0	
Bury Mainland - Island Waterline	70.0	70.0					
Line Mainland - Island Waterline	20.0	20.0					
Spring Collection System	60.0	60.0					
Mainland Treatment Plant and Reservoir	400.0		400.0				
Mainland Transmission Line	100.0		100.0				
Island Distribution System Improvement	80.0				80.0		
Servicing Balance of Island and Highway Commercial	40.0			40.0			
Utilities - Sewer							
Soiltesting and Investigations	10.0	10.0					
Engineering Design	30.0	5.0	15.0	10.0			
Construction	(510.0)	(20.0)		(490.0)			
Aerated Lagoons	250.0			250.0			
Mainland Outfall	60.0			60.0			
Island Lift Station & Main	120.0			120.0			
Rehabilitate Island Mains	20.0	20.0					
Servicing Balance of Island and Highway Commercial	60.0			60.0			
Causeway and Access Roads							
Soiltesting and Investigations	10.0	10.0					
Engineering Design	10.0	10.0					
Construction	(275.0)	(30.0)	(245.0)				
Causeway	170.0		170.0				
Mainland Access Road	70.0	30.0	40.0				
Island Access Road	35.0		35.0				
Erosion Control							
Study & Engineering Design	10.0			10.0			
Construction	100.0				100.0		
Subtotals							
Legal Surveys & Mapping	18.0	8.0		10.0			
Engineering Design & Study	165.0	30.0	40.0	45.0	35.0	15.0	
Soiltesting & Investigation	25.0	25.0					
Construction **	(3,145.0)	(260.0)	(745.0)	(920.0)	(330.0)	(640.0)	(250.0)
Industrial Areas	150.0	60.0		90.0	50.0	440.0	250.0
Residential Development	1,040.0			300.0	180.0	200.0	
Utilities - Water	1,070.0	150.0	500.0	40.0			
Utilities - Sewer	510.0	20.0		490.0			
Causeway & Access Roads	275.0	30.0	245.0				
Erosion Control	100.0				100.0		
TOTALS	3,353.0	323.0	785.0	975.0	365.0	655.0	250.0

* Costs borne by private developer.

** Construction supervision included in construction cost.

A P P E N D I X "A"

SOIL TESTS AND BORE HOLE LOGS

consulting civil engineers

G.R. Gilchrist, MSc. P.Eng.
vice president

August 14, 1972

W.J. Francl & Associates
Consulting Engineers Ltd.
#204, 11445 - 124 Street
Edmonton, Alberta

Attention: Mr. J. Patterson, P. Eng.

Gentlemen:

Subject: Ft. Simpson -- Permeability Testing

Two soil samples were submitted to our laboratory on August 5, 1972. Sample No. 1 was a fine to medium grained sand, while Sample No. 2 was a clayey silt with some organics. We were required to test for or estimate the permeability coefficient of both samples.

Sieve analyses were carried out on both samples and results are enclosed as Figures No. 1 and 2, for the sand and clayey silt, respectively. Sample No. 1 was tested in a 2 inch diameter, 6 inch high permeameter, which was vibrated to obtain maximum density of the sample.

The following results were obtained:

Moisture Content (Natural)	4.6 %
Dry Density	88.9 P.C.F.
Void Ratio	0.89
Permeability Coefficient	1.8×10^{-2} cm/sec.
Test Temp.	20° C

Atterberg Limit tests were performed on Sample No. 2. The following results were obtained.

Natural Moisture Content	8.7 %
Liquid Limit	40.8 %
Plastic Limit	26.8 %
Plasticity Index	14.0

E.W. Brooker & Associates Ltd. 11738 Kingsway Avenue Edmonton 19 Alberta phone (403) 453-3665

Based on the above limit results, grain size distribution curve, and, visual observation of the material, it is believed that the permeability coefficient of the clayey silt is about 10^{-6} to 10^{-7} centimeters per second. If the soil mass insitu contains sand lenses, the macro permeability will be significantly greater. This material would be described as being of very low permeability.

We trust the enclosed data meets your present requirements. Should any further testing be required, please contact our office.

Respectfully Submitted,

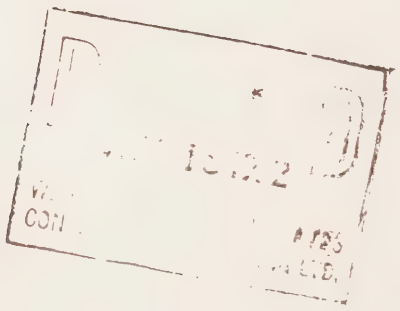
ELMER W. BROOKER & ASSOCIATES LTD.

G. Gilchrist, P. Eng.

Hugh Carss, Supervising Technician

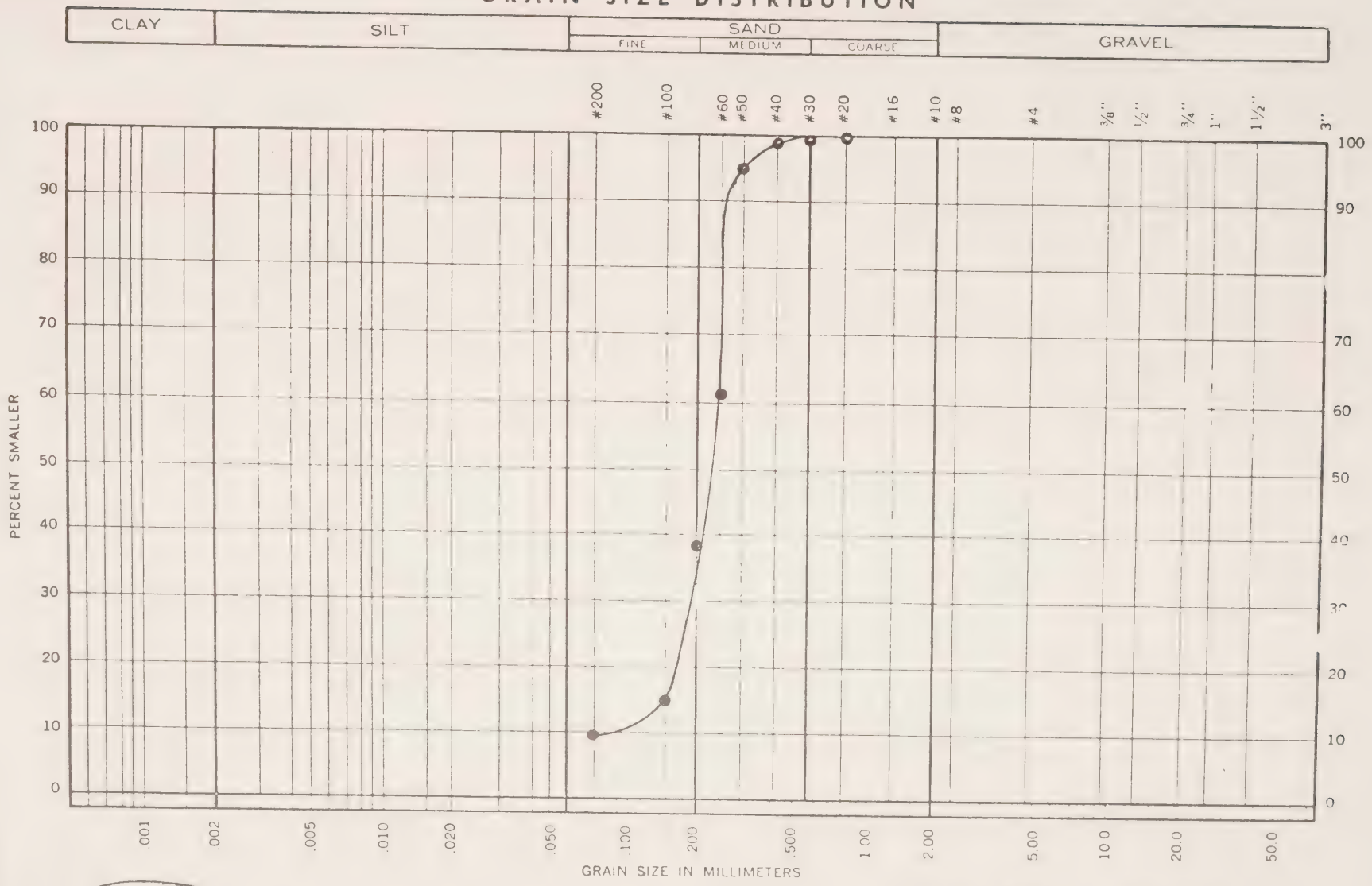
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Enclosures:



E.W. Brooker & Associates Ltd.

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

SAMPLE DESCRIPTION: FINE MEDIUM SAND

PROJECT: FORT SIMPSON
JOB No. C-373 DATE 9 AUG. '72
SAMPLE No
DEPTH

FIGURE 1

77

GRAIN SIZE DISTRIBUTION

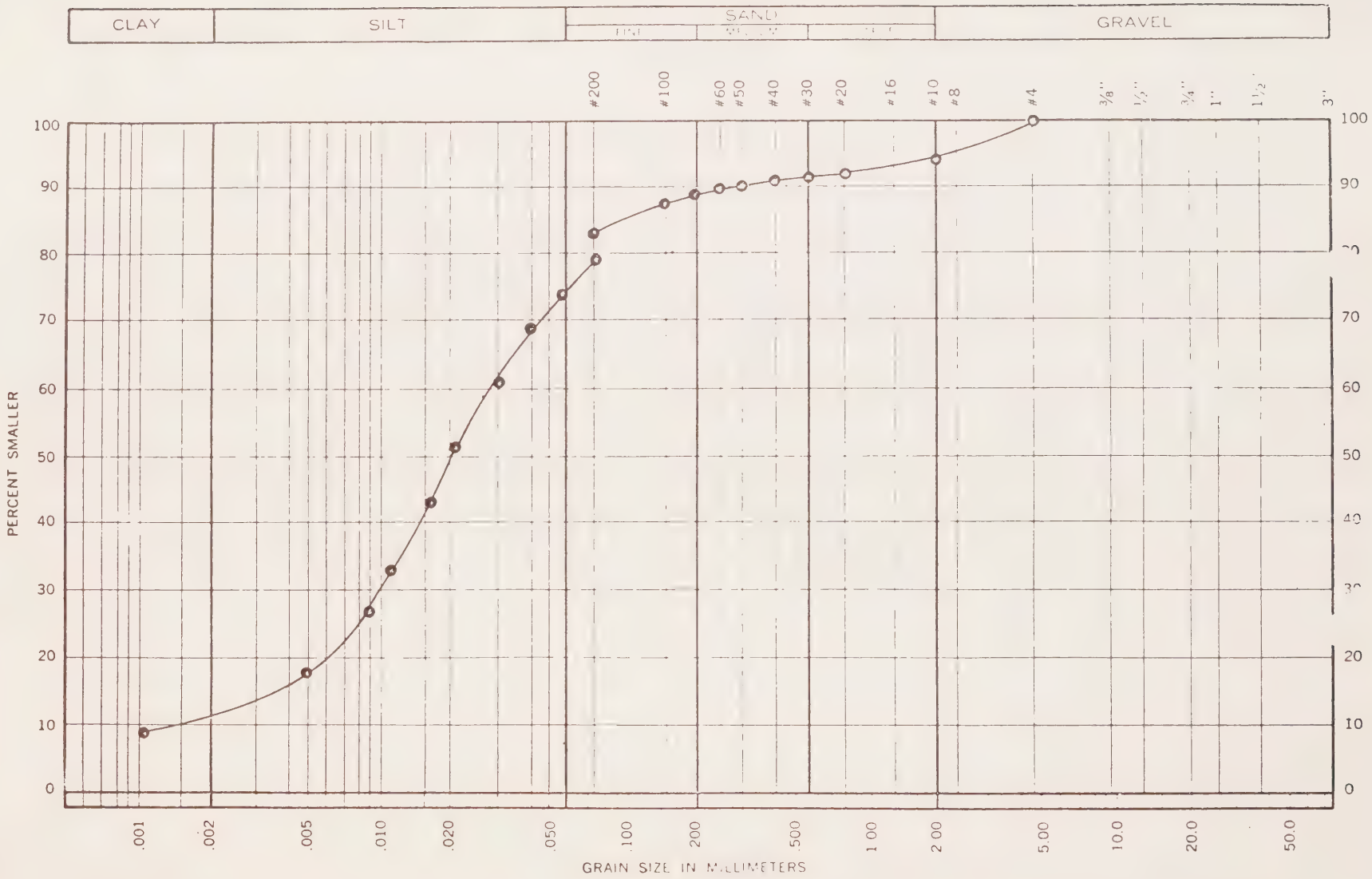


FIGURE 2

BROOKER & ASSOCIATES

SAMPLE [illegible] SILT SANDY
SOME PEBBLES

PROJECT FORT SIMPSON
JOB No C-373 DATE 10 AUG. '72
SAMPLE No
DEPTH

consulting civil engineers

E.W. Brooker & Associates Ltd.
11738, Kingsway Avenue, Edmonton 19, Alberta
phone (403) 453-3665

September 26, 1972

W. J. Francl & Associates
Consulting Engineering Ltd.
204 11445 - 124 Street
Edmonton, Alberta

Attention: Mr. J. Patterson, P. Eng.

Gentlemen:

Subject: Proposed Fort Simpson Subdivision Development - Fort Simpson, N.W.T.

At the request of Mr. J. Patterson, P. Eng., of W. J. Francl & Associates, a geotechnical investigation was carried out for a proposed new subdivision development in Fort Simpson, N.W.T. The field investigation was conducted in two parts, commencing on August 22, 1972.

I. TESTHOLE LOCATIONS

The first part of the field investigation was carried out utilizing a backhoe and hand auger equipment to gain knowledge of and obtain representative samples of subsurface soils. Existing borrow pits, test pits and road cuts in the area were also examined and logged to provide additional detail on the subsurface soils.

A total of 13 pits or borings were undertaken and logged during the first part of the field investigation. Six excavations and/or borings (Testholes 1, 1A, 2, 2A, 3 and 3A) were logged in the trailer park area, which lies approximately 4 miles south of the Town of Fort Simpson on the existing Mackenzie Highway. Testholes 4, 6 and 7 were also located along the Mackenzie Highway. Testhole 4 was located at approximately Mile 292 of the existing Mackenzie Highway, in a CMHC area south of the proposed trailer park. Testholes 6 and 7 were located within the mainland

area adjacent the town, at the point where the existing highway turns north prior to crossing the old river channel to the townsite. Testholes 8 and 9 (backhoe pits) were located within the easterly end of the mainland area lying south of, and adjacent to the existing settlement. The holes were excavated on an existing cutline extending between the existing Mackenzie Highway alignment and the proposed new alignment further to the south. Testhole 5 was a sewer trench within the existing town, and Testhole 10 was a backhoe pit excavated south of the proposed Telsat Station lying at the northwest end of the existing townsite. A site plan showing the relative location of the testholes to existing features has not been included, as locations were to be determined by W.J. Francl personnel and are presently unavailable.

The second part of the field investigation commenced on September 7, 1972 and consisted of dry augering 11 borings, with a power auger, in the proposed mainland area lying to the south of the existing town. The approximate locations of the borin (Testholes 1B to 11B inclusive) are shown on the attached sketch plan Drawing 38.

II. SITE CONDITIONS

2.1 Surface Features

2.1.1 Proposed Trailer Park Area - Approximately 4 Miles South of Town Site

The proposed trailer park area investigated lies on the north side of the existing Mackenzie Highway in an area covered with poplar and spruce tree growth. The topography is gently undulating with fair to moderately good surficial drainage. Some low wet areas exist within the limits of the site.

2.1.2 Testhole 4 (CMHC Area South of Trailer Park Area)

Testhole 4, being located a short distance south of the proposed trailer park area, lies within similar terrain conditions.

2.1.3 Testholes 5 and 10 - Existing Town Site

Testholes 5 and 10 are located in and at the northeast end of the town site, respectively. As the existing townsite occupies an island within the Mackenzie river, the topography of the area is relatively flat, except for that portion of the island that exists immediately adjacent to the active river channel which dips steeply toward the river. Testhole 5 was in the downtown area which is void of vegetation and is developed. Testhole 10 was located south of the site of the proposed Telsat Station, which is presently partially tree covered. Surficial drainage of the area is moderately good.

2.1.4 Mainland Area South of Existing Town Site

This area of land lies immediately south of the existing townsite on the south bank of the Mackenzie River. Apart from the slope of the river valley, the area is relatively level, and the terrain is gently undulating. Small wet depressions exist within the area. Tree growth consists predominantly of heavy poplar and spruce cover. Surficial drainage is fair.

2.2 Subsurface Features

2.2.1 Proposed Trailer Park Area - Approximately 4 Miles East of Town Site

Three pits (Testholes 1, 2 and 3) and three hand auger holes (Testholes 1A, 2A and 3A) were advanced in the general area of the proposed trailer park. The detailed logs are presented as Drawings No. 1 to 6, inclusive, and are attached. The generalized stratigraphy noted at the site is summarized below, with pertinent comments on features which may affect future design and construction decisions.

Material	Description	Average Depth Below Grade (ft)	Range of Thickness (ft)
ORGANICS		0 - 0.25	0.1 - 0.6
SAND	brown changing to grey with depth, silty, fine grained, uniform, medium dense	0.25 - Maximum Depth of Penetration	Not Established

NOTE:
1. Testhole 1 revealed some grey, highly plastic clay at 17 feet , and Testhole 3 revealed the same type of clay at a depth of 12 to 15 feet.
2. A layer of light brown sandy silt extended from 3 inches to 3 feet in Testhole 3A.
3. Water levels were observed in the test pits and borings as follows.

Testhole No.	Depth of Excavation (ft)	Depth to Water Surface (f
1	17	10 at 2 hrs.
1A	3.5	Dry
2	15	Dry but pit sloughing from
2A	3.5	Dry
3	15	10'
3A	3	Dry

Water levels indicated above are at the time of completion or as otherwise noted.

2.2.2 Testhole 4 (CMHC Area South of Trailer Park Area)

Testhole 4 consisted of an excavation, in an existing highway borrow pit along the Mackenzie Highway, approximately one-half mile south of the proposed trailer park area. As in the trailer park area, sand was exposed to the maximum depth of excavation and the pit sloughed in at a depth of 12 feet. A detailed log of the test pit is presented as Drawing No. 7.

2.2.3 Testholes 5 and 10 - Existing Town Site

Testholes 5 and 10 consisted of an existing sewer trench excavation in the approximate town center and a backhoe pit south of the Telsat site, at the north end of the town, respectively. In both pits sandy silt was exposed to the maximum depth of penetration, and frozen ground was encountered from depths of about 4 to 6 feet below grade and existed to the depth of penetration. Excess ice was noted in quantities ranging from about 2% to 10%. No free water was observed in either of the excavations. Detailed logs of the test pits are presented as Drawings No. 8 and No. 13.

2.2.4 Mainland Area Adjacent to Existing Town Site

During the course of the first part of the field investigation, two borrow pits adjacent the existing Mackenzie Highway, at the point where the highway turns north to cross the old river channel at the townsite, were inspected and the materials were logged. The logs of the pits, designated Testholes 5 and 7, are presented as Drawings No. 9 and 10, respectively. In addition, two backhoe test pits, Testholes 8 and 9, were excavated along a cutline extending between the existing Mackenzie Highway and the future proposed alignment of the highway, along the easterly side of the area. The logs of these two pits are presented as Drawings No. 11 and 12. The excavations revealed a fine grained silty sand overlying a fine sandy and clayey silt to the depth of penetration. No groundwater seepage was apparent in either of the two old borrow pits along the highway. However, Testholes 8 and 9 in the easterly portion of the area, both revealed seepage and sloughing soil conditions. Testhole 8 encountered seepage water at a depth of 4 feet, and sloughing soil conditions were relatively severe below a depth of about 6 feet. Testhole 9 also revealed seepage water, which was measured at a depth of 3 feet, with frozen soil conditions extending from $3\frac{1}{2}$ feet to about 7 feet. Severe sloughing and seepage was also encountered below the 7 foot depth.

The second part of the investigation consisted of dry augering 11 boreholes (Testholes 1B to 11B, inclusive) within the mainland area, at locations accessible to a truck mounted drill rig. The borehole locations are shown approximately on Drawing No. 38, attached. The borings ranged from 9 to 26 feet in depth.

The generalized soil stratigraphy, based on observations obtained from the borings, is summarized as follows.

Material Description		Average Depth Below Grade (ft)	Range of Thickness (ft)
SAND AND/OR SILT	medium brown to grey silty sand or fine sandy silt, moist to wet, medium dense	0 - 12.2	4.5 - 25.5
CLAY	grey, some silt, low to highly plastic, firm to stiff	12.2 - Maximum Depth of Penetration	Not Established

NOTE: 1. The maximum depth of penetration was 26 feet.

2. The following depths to slough, water and frost were noted in the respective boreholes.

Borehole No.	Depth to Slough (ft)	Depth to Water (ft)	Depth to Frost (ft)
TH1B	N.A.	4.5	9.5
TH2B	12.0	No free water	No frost
TH3B	8.0	No free water	No frost
TH4B	8.0	No free water	No frost
TH5B	5.5	No free water	24.0
TH6B	No Slough	No free water	3.0
TH7B	No Slough	No free water	11.0
TH8B	No Slough	No free water	9.0
TH9B	9.0	No free water	No frost
TH10B	2.5	No free water	9.0
TH11B	No Slough	No free water	3.0

Detailed borehole logs are attached as Drawings No. 23 to 33, inclusive.

III. LABORATORY TESTING

Laboratory testing was carried out on representative samples to determine the natural moisture content, Atterberg limits, and grain size distribution of the subsoil. The results of the testing program are presented on the borehole logs, where applicable, and on the Summary of Results Sheet Drawing No. 37. Grain size distribution curves are presented on Drawings No. 14 to 22, inclusive, and on Drawings No. 34 to 36, inclusive.

Based on the grain size distribution curves, the soils of the area generally appear to consist of uniform fine and medium grained sands, and well graded sandy silts. The frost susceptibility of these materials varies from moderate to severe.

Frozen ground (permafrost and/or seasonal frost) was encountered in a number of excavations in the field. Ice contents, based on visual appraisal, are believed to range from a trace to about 10% by volume. Although visible ice crystals were noted, no major lensing of ice was detected in any of the boreholes.

IV. OBSERVATIONS AND CONCLUSIONS

4.1 Proposed Trailer Park Area - Approximately 4 Miles South of Existing Town Site

The following observations and conclusions are presented concerning the subsoil conditions at the proposed trailer park site.

4.1.1 The subsurface soils consist generally of moderately frost susceptible, uniform fine to medium grained sands. No frozen ground was detected in any of the borings or test pits, within the depths of exploration. However, seepage water and sloughing soil conditions were noted in several of the test pits at depths of about 7 to 10 feet below grade.

4.1.2 Based on observations of subsoil conditions at the site, it is believed that construction of a trailer park within the area is feasible. The subsoils are believed to provide adequate support for trailer structures founded on shallow foundations. However, as the subsoils are moderately frost susceptible, some movement of shallow foundations due to frost heaving may be expected.

4.1.3 Although frozen ground was not encountered in the exploratory excavations the proximity of the water table to the surface (7 to 10 foot depth) is expected to present difficulties in installation of utilities and service below this depth. Seepage and sloughing soil conditions can be expected in excavations below about 7 to 10 feet below existing grade.

4.2 Testholes 4 (CMHC Area South of Trailer Park Area)

4.2.1 Testhole 4, revealed similar subsoil conditions to those encountered in the trailer park area. Although no other testholes were excavated in this area, it is expected that the conditions will be similar throughout the area and the conclusions presented for the trailer park area may be generally applicable.

4.3 Testholes 5 and 10 - Existing Town Site

4.3.1 Sandy silt of high frost susceptibility was noted in both excavations in the existing town site. Seasonal frost and/or permafrost was observed to extend from depths of about 4 to 6 feet below grade to the maximum depth of penetration of 12 feet. Ice contents in the subsoil were noted to ran from about 2 to 10 percent by volume and existed in the form of segregate crystals. No seepage water or sloughing soil conditions were noted.

4.3.2 Based on the limited information available from the two test excavations, it is believed that footing foundations are impractical and undesirable in areas exhibiting frozen ground conditions. In these areas, pile foundations are considered necessary. In areas that are free of frozen ground conditions, footings may be feasible. However, the design of any foundation system in this area should be based on a detailed foundation investigation at the site of the proposed development.

4.3.3 With respect to utilities installation, frozen ground conditions will present difficulties in excavating trenches, and in subsidence and possible sloughing of thawed soils. In areas free of frozen ground, the water table may be relatively high.

4.4 Mainland Area Adjacent to Existing Town Site

4.4.1 Moderately to highly frost susceptible silty sand and/or sandy silt was encountered as the near surface subsoils within this area. Underlying the silt and/or sand, at depth, was a silty clay of low to high plasticity. Seepage and sloughing soil conditions were prevalent in most of the excavations carried out in the area, and frozen ground was encountered in approximately one-half of the excavations. Seepage and slough were encountered as near to the surface as 2.5 feet below existing grade, and frost was noted as near to the surface as 3.0 feet in depth.

4.4.2 Based on observations in the excavations carried out, it is considered that this area is a relatively poor area with respect to development of foundations and installation of utilities. A high water table coupled with sporadic frozen ground conditions will contribute problems to both installation and operation of foundations and utilities. Pile foundations are presently considered to be the only feasible means of foundation support within the area. However, the design of any foundation system

should be based on a detailed foundation investigation at the specific location of any development.

V. CLOSURE

The foregoing information is presented, based on the geotechnical evaluation of findings in boreholes, hand auger holes, backhoe test pits and existing borrow pits within the study area. A total of 23 excavations were logged and numerous representative samples were taken for laboratory analysis. The conditions noted in the excavations are believed to be representative of the areas discussed and the general observations and conclusions presented are believed to be applicable. However if conditions other than those presented herein are noted during subsequent phases of this project, we should be notified in order that our recommendations may be evaluated in light of new findings.

Respectfully Submitted,

ELMER W. BROOKER & ASSOCIATES LTD.

Elmer Brooker

per Lawrence A. Balanko, P. Eng.

Garry R. Gilchrist, P. Eng.

LAB:sjw

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES
(SHOWN IN SYMBOL COLUMN)



Gravel | Sand | Silt | Clay

Predominant type shown heavy

POSITION OF FREE)UND WATER IN BOREHOLE

SAMPLER TYPES
(SHOWN IN SAMPLES COLUMN)



Shelby Tube | Piston | Split Spoon | No Recovery

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N BLOWS PER FOOT
Loose	0 to 40%	0 to 10
Medium, dense	40 to 70%	10 to 30
Dense	70 to 100%	30 to 50

The number of blows, N, on a 2" O.D. split spoon sampler of a 140 lb. wt. falling 30" required to drive the sampler a distance of 1' from 6" to 18'

FINE GRAINED SOILS (major portion passing the 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ FT
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided — having inclined planes of weakness that are slick and glossy in appearance.

Fissured — containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated — composed of thin layers of varying color and texture.

Interbedded — composed of alternate layers of different soil types.

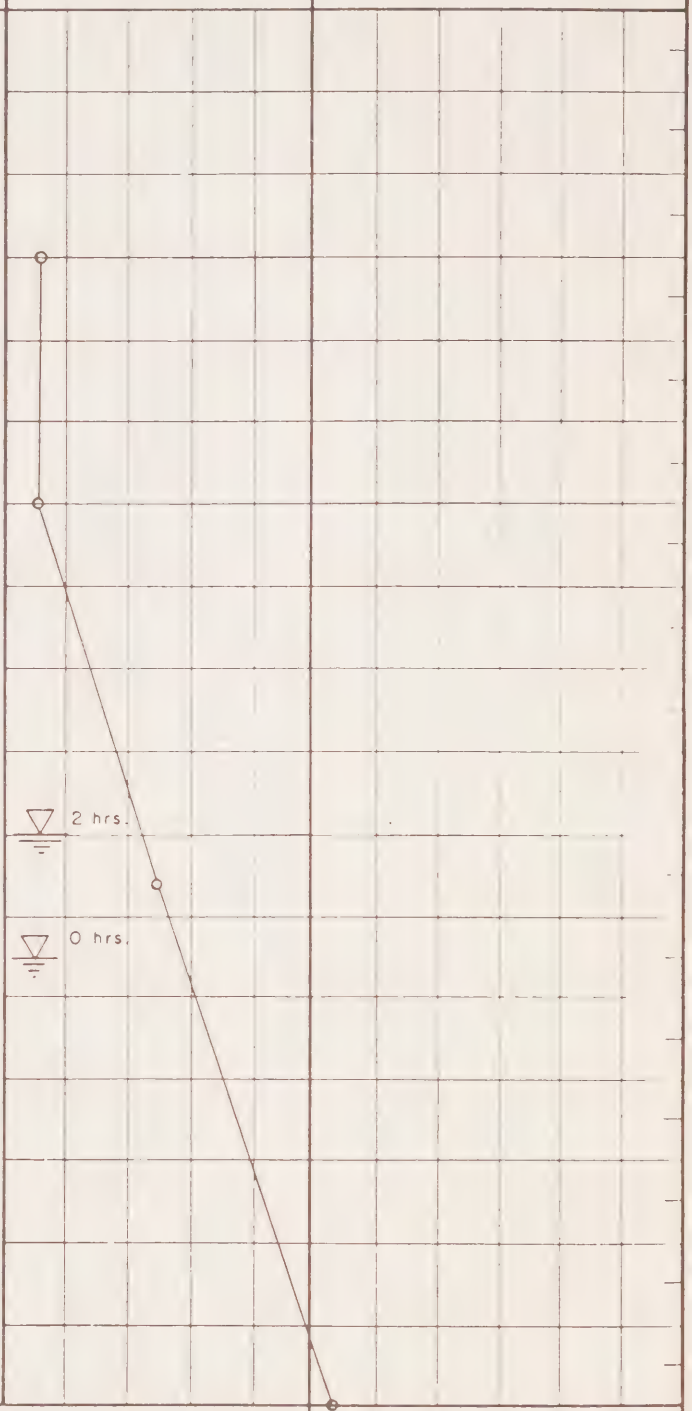
Calcareous — containing appreciable quantities of calcium carbonate.

Well graded — having wide range in grain sizes and substantial amounts of all intermediate particle sizes.

Poorly graded — predominantly of one grain size, or having a range of sizes with some intermediate size missing.

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	1
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	ORGANICS TO 1"
1	SAND brown uniform few pebbles rootlets medium density fine to medium grained
2	
3	
4	
5	brownish grey
6	
	Borrow Pit Face
7	
	Backhoe Pit
8	
9	dark grey sandy few pebbles
10	
11	free water sloughing badly
12	
13	
14	
15	
16	clayey silt, grey, bentonitic
17	END OF HOLE



Completion Depth 17' Date Aug 22/72

Depth to Water in Boring 11.5' @ 0 hrs.
10' @ 2 hrs.

Page 1 of 1

Dwg. No. 1

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	1A
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % o (10 20 30 40)	Compressive Strength tsf (1 2 3 4 5)
	ORGANICS TO 5"		
1	SAND silty fine grained brown small roots		
2	brownish grey very silty		
3	silt sand	o	
4	END OF HOLE		
	NOTE: Hole drilled with a hand auger		

Completion Depth 3.5' Date Aug 23/72

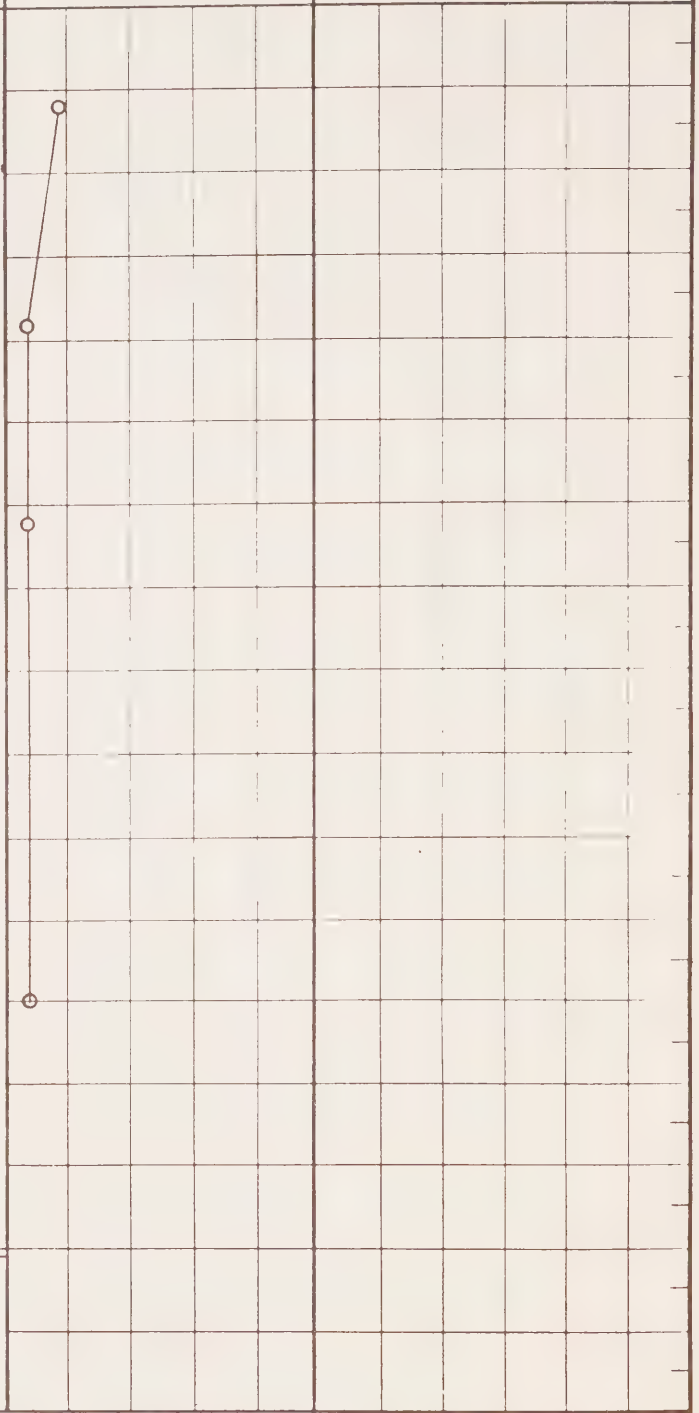
Depth to Water in Boring Dry Page 1 of 1

Penetration Resistance N (10 20 30 40 50)

Dwg. No. 2

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	2
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	ORGANICS TO 1"
	SAND fine grained
1	silty
	roots
	brown
2	brownish grey below 1.5'
	numerous silt lenses
3	
4	
5	
6	silt lenses
	brownish grey
7	sand
	fine to medium grained
	some oxides
8	blackish brown below 7'
	sloughing below 7'
9	
10	
11	
12	
13	
14	
15	
	END OF HOLE
16	NOTE: Pit dug with backhoe Pit sloughing badly



Completion Depth	15'	Date	Aug 22/72
Depth to Water in Boring	Dry	Page	1 of 1

10 20 30 40 50
Penetration Resistance N

Dwg. No. 3

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	2A
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % O (10 20 30 40)	Compressive Strength tsf. (1 2 3 4 5)
	ORGANICS TO 3"		
1	SAND very silty on surface brown roots fine grained		
2			
3	blackish brown silt lumps	O	
4	END OF HOLE		
	NOTE: Hole dug with hand auger		

Penetration Resistance N (10 20 30 40 50)

Completion Depth 3.5' Date Aug 23/72

Depth to Water in Boring Dry

Page 1 of 1

Dwg. No. 4

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	3
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % O (10 20 30 40)	Compressive Strength tsf. (1 2 3 4 5)
	ORGANICS TO 1"		
1	SAND blackish brown fine to medium grained silty some roots		
2	few pebbles		
3	hole sloughing		
4			
5	clean medium grained	O	
6			
7	moist		
8			
9			
10	very moist	▽	
11			
12			
	CLAY dark grey free water bentonitic		
15			
	END OF HOLE		
16	NOTE: Pit dug with backhoe Pit sloughing badly		

Completion Depth	15'	Date	Aug 22/72	10 20 30 40 50
Depth to Water in Boring	10'	Page	1 of 1	Penetration Resistance N
				Dwg. No. 5

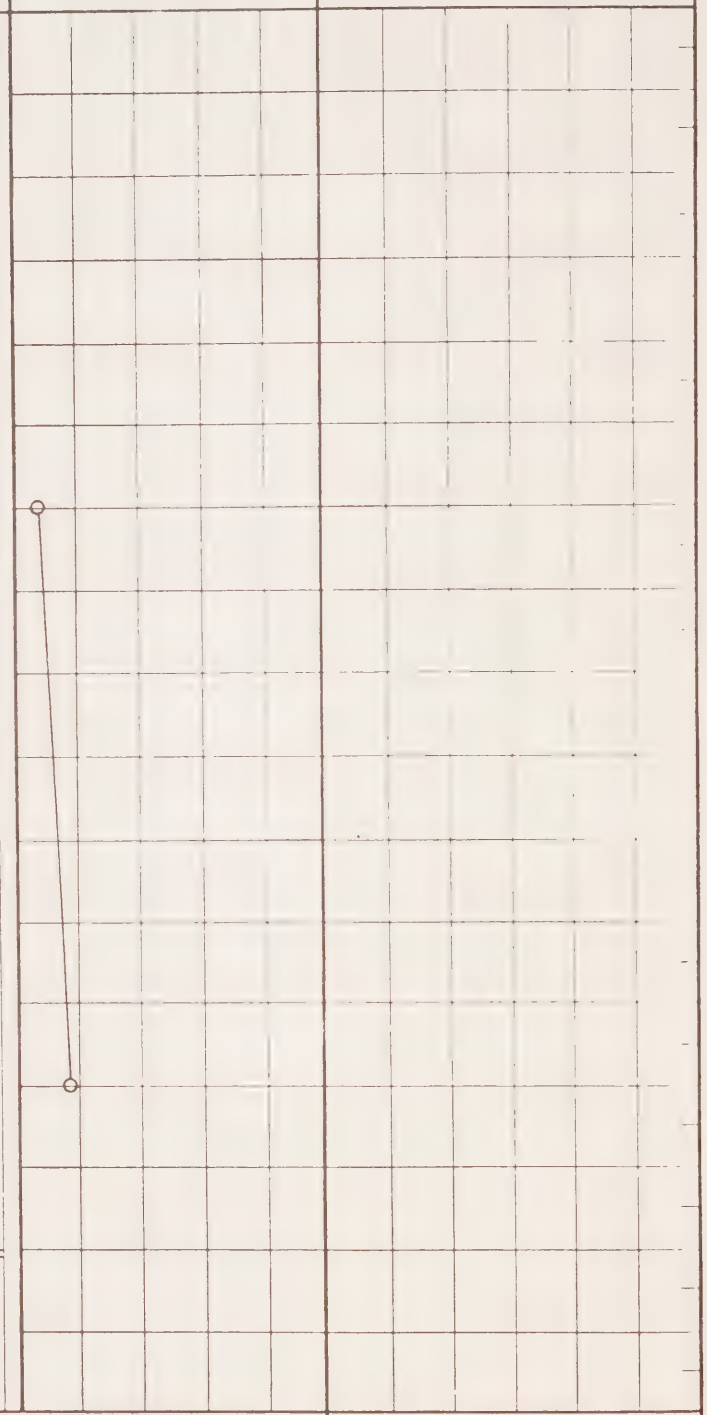
PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	3A
SURFACE ELEVATION		JOB No.	E - 489

Depth ft.	SOIL DESCRIPTION	Water Content % O 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
	ORGANICS TO 3"		
1	SILT light brown some roots dry crumbly		
2		O	
3	END OF HOLE		
4	NOTE: Hole drilled with hand auger		

	Completion Depth	3'	Date Aug 23/72	10 20 30 40 50
eda	Depth to Water in Boring	Dry	Page 1 of 1	Penetration Resistance N
				Dwg. No. 6

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	4
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	ORGANICS TO 1"
1	SAND fine grained
	some silt
	light to medium brown
2	roots
	dark brown below 2'
3	pebbles
4	
5	
	brownish black
6	medium grained
7	
8	
9	
10	face of pit sloughing
11	
12	
13	
14	
15	
	END OF HOLE
16	
	NOTE: Pit sloughed to 12'



Completion Depth	15'	Date	Aug 23/72
Depth to Water in Boring	Dry	Page	1 of 1
Dwg. No.	7		

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	5
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
1	OIL STABILIZED GRAVEL TO 4"
	SILT sandy
	grey
2	
3	
4	
5	
6	frozen
	excess ice 2% - 5%
7	temperature 26°F
8	
9	
10	
11	
12	
	END OF HOLE
13	
	NOTE: Sewer trench

Water Content % O — 10 20 30 40

Compressive Strength tsf. — 1 2 3 4 5

Completion Depth	12'	Date	Aug 24/72
Depth to Water in Boring	Dry	Page	1 of 1

Penetration Resistance N — 10 20 30 40 50

Dwg. No. 8

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	6
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % O (10 20 30 40)	Compressive Strength tsf. (1 2 3 4 5)
	ORGANICS to 1"		
1	SAND silty roots and rootlets fine grained brown and grey		
2			
3			
4	brownish black medium grained		
5			
6			
7	roots and rootlets to 7'		
8	lumps of silt		
9			
10			
11			
12			
13			
14			
15	silty		
16	grey		
17			

eba	Completion Depth	40'	Date Aug 24/72	10 20 30 40 50
	Depth to Water in Boring	Dry	Page 1 of 3	Penetration Resistance N
				Dwg. No. 9a

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	6
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
18			
19			
20	very silty		
	very moist		
21			
22			
	SILT dark grey		
	some clay		
23	medium plasticity		
24			
25			
	drier		
26	crumbly		
	brown		
	trace of sand		
27			
28			
29			
30			
31	sandy		
32			
33			
34			

Completion Depth	40'	Date	Aug 24/72
Depth to Water in Boring	Dry	Page	2 of 3

10 20 30 40 50
Penetration Resistance N

Dwg. No. 9b

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	6
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
35			
36			
37			
38			
39	greyish brown		
	silty sand		
40	END OF HOLE		
	NOTE: Erosion gullies noted on pit wall. Angle of repose of slough 40° - 45°		

Completion Depth	40'	Date	Aug 24/72	10 20 30 40 50
Depth to Water in Boring	Dry	Page	3 of 3	Penetration Resistance N
				Dwg. No. 9c

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	7
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % ○ 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
1			
2			
3			
4			
5			
6			
7			
8	stripped to 8'		
9	SAND silty fine grained brown		
10			
11			
12			
13	grey		
14	very silty very moist		
15			
16	SILT clayey medium plastic very stiff		
17			

Completion Depth 25' Date Aug 24/72

Depth to Water in Boring Dry Page 1 of 2

10 20 30 40 50

Penetration Resistance N

Dwg. No. 10a

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	7
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
18	clayey silt dark grey		
19			
20			
21			
22			
23			
24			
25			
26	END OF HOLE		

Completion Depth 25' Date Sug 24/72

Depth to Water in Boring Dry

Page 2 of 2

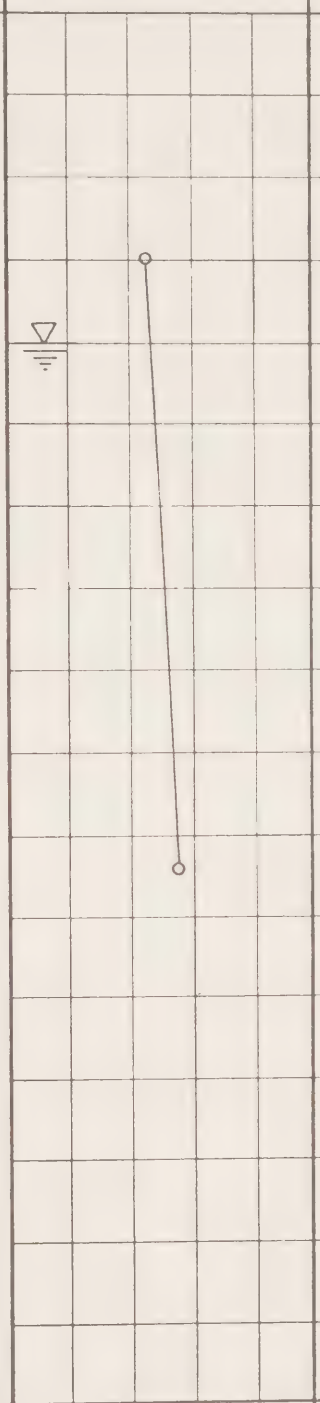
10 20 30 40 50

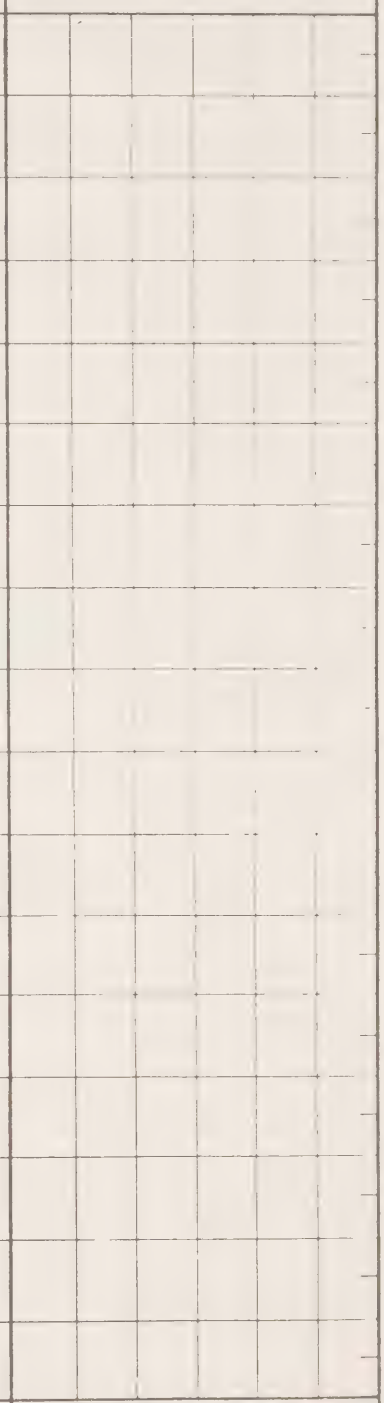
Penetration Resistance N

Dwg. No. 10b

PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	8
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	ORGANICS to 3"
1	SAND silty grey some roots and rootlets
2	
3	SILT sandy grey and brown
4	40°F trace of groundwater
5	
6	seepage water sloughing badly
7	
8	
9	
10	
11	END OF HOLE





Completion Depth 10.5' Date Aug 24/72

Depth to Water in Boring 4' Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 11

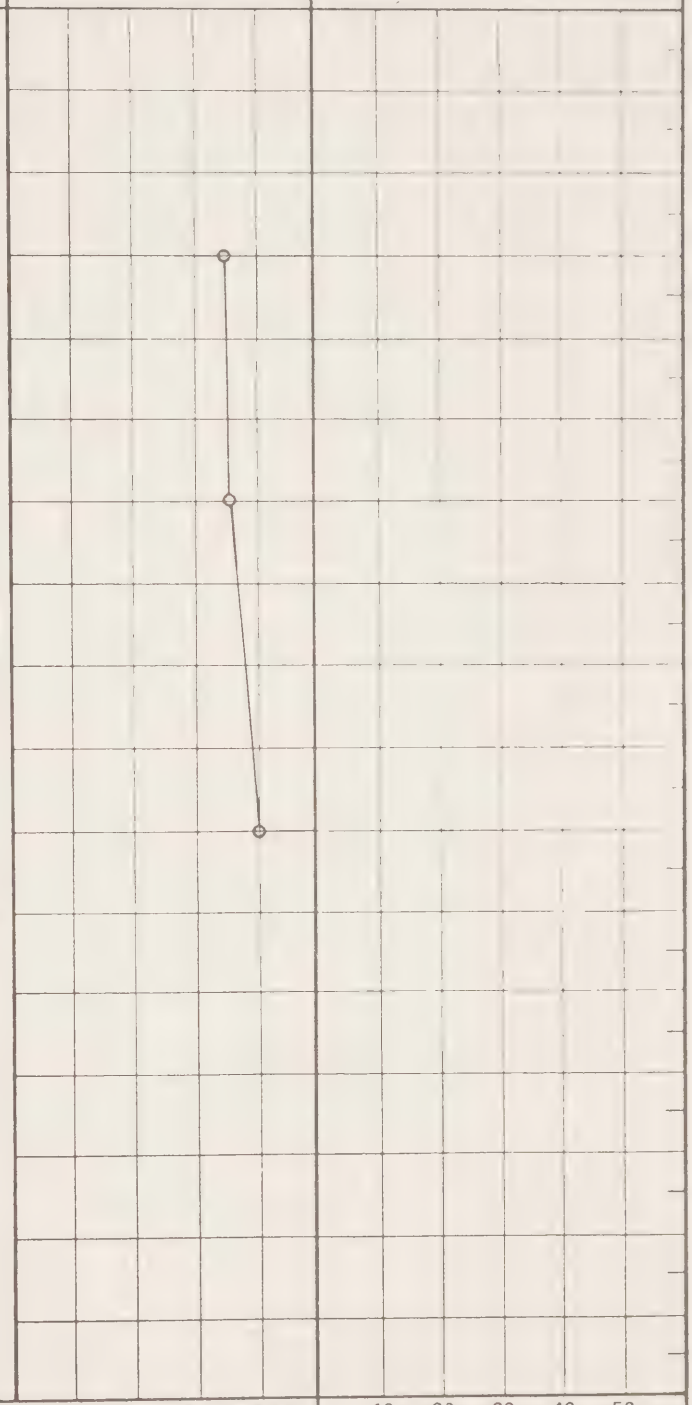
PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	9
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
1	ORGANICS peat leaves twigs		
2	SAND silty grey		
3	free water frozen 24°F	▽	
4			
5	24°F		
6			
7	pit sloughing large flow of groundwater		
8			
9	END OF HOLE		
	NOTE: Permafrost evident in south side of pit but not on north face		

eba	Completion Depth 8'	Date Aug 24/72	10 20 30 40 50
	Depth to Water in Boring 3'	Page 1 of 1	Penetration Resistance N
			Dwg. No. 12

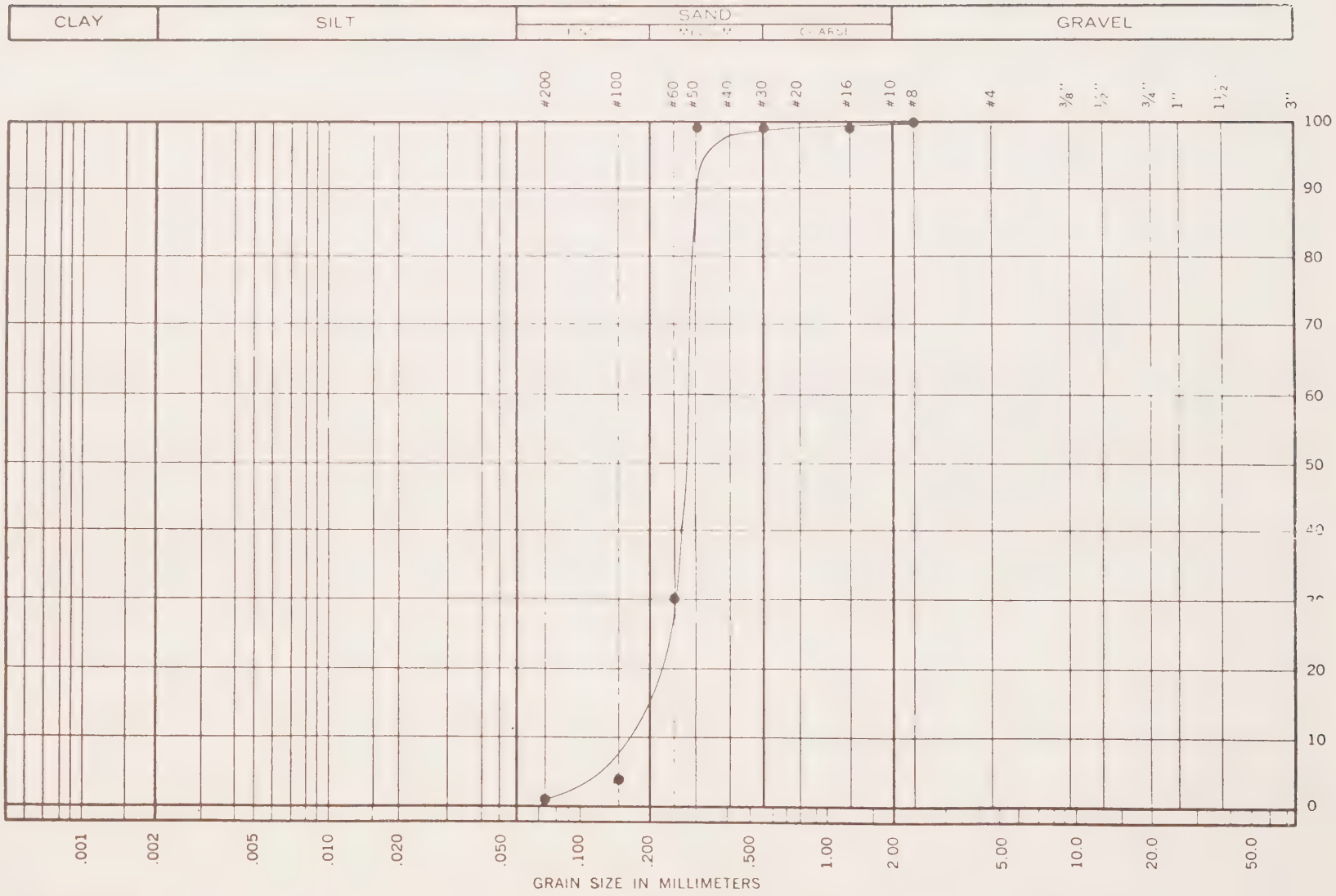
PROJECT	Ft. Simpson Subdivision	TESTHOLE No.	10
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	ORGANICS peat roots
1	SILT greyish brown
2	
3	organics
4	fine sand, FROZEN 29°F some peat blackish brown silt and sand layers
5	
6	
7	25°F no excess ice evident
8	
9	
10	ice content 10% 26°F marine shells
11	clayey, 30°F
12	END OF HOLE



Completion Depth	11'	Date	Aug 24/72
Depth to Water in Boring	Dry	Page	1 of 1
Dwg. No.	13		

GRAIN SIZE DISTRIBUTION



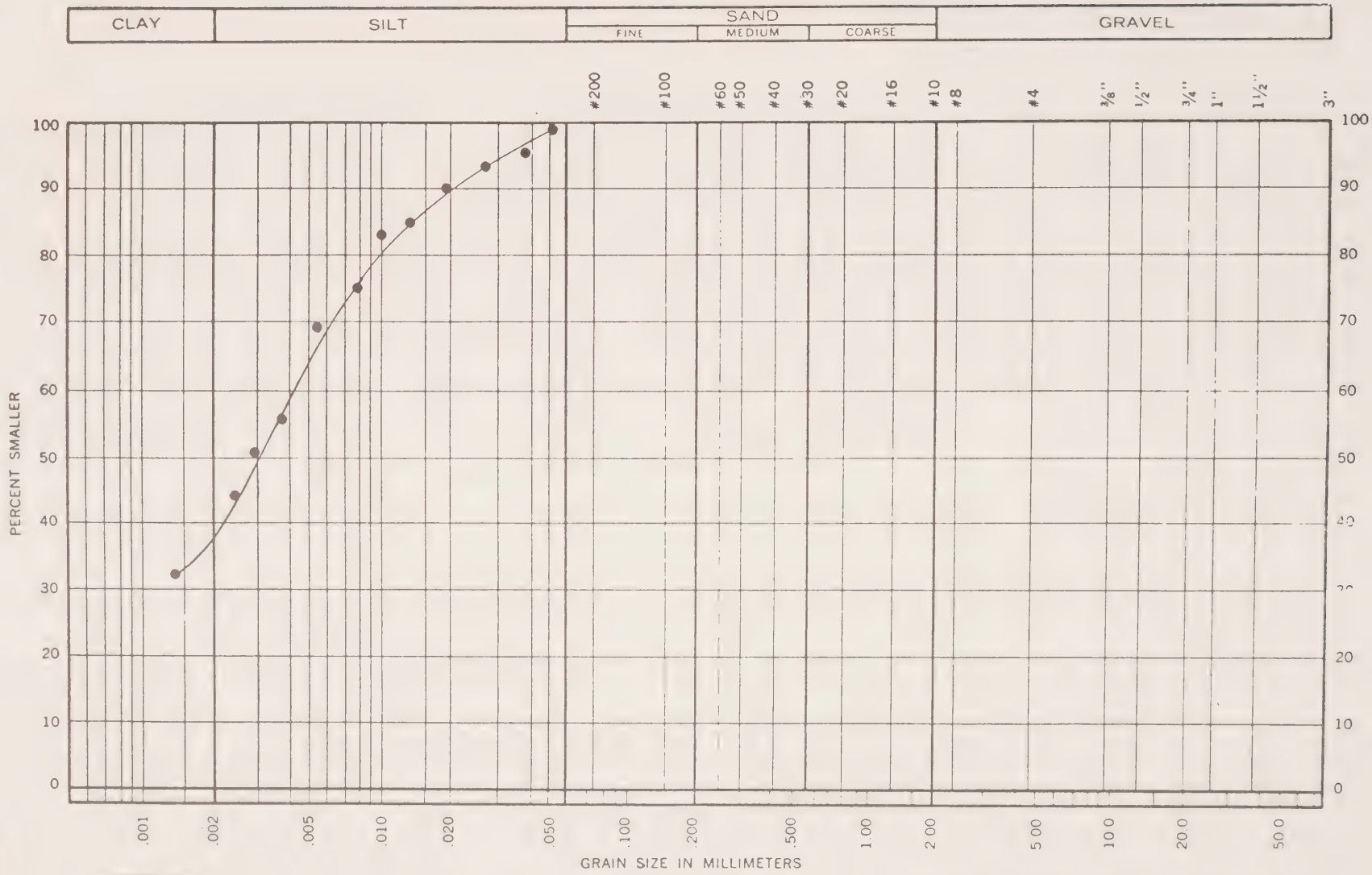
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION: SP
Poorly Graded Clean Sand

PROJECT Ft. Simpson Subdivision
JOB No. E-498 DATE Sept 6/72
SAMPLE No. TH #1
DEPTH 6'

FIGURE 4/

GRAIN SIZE DISTRIBUTION



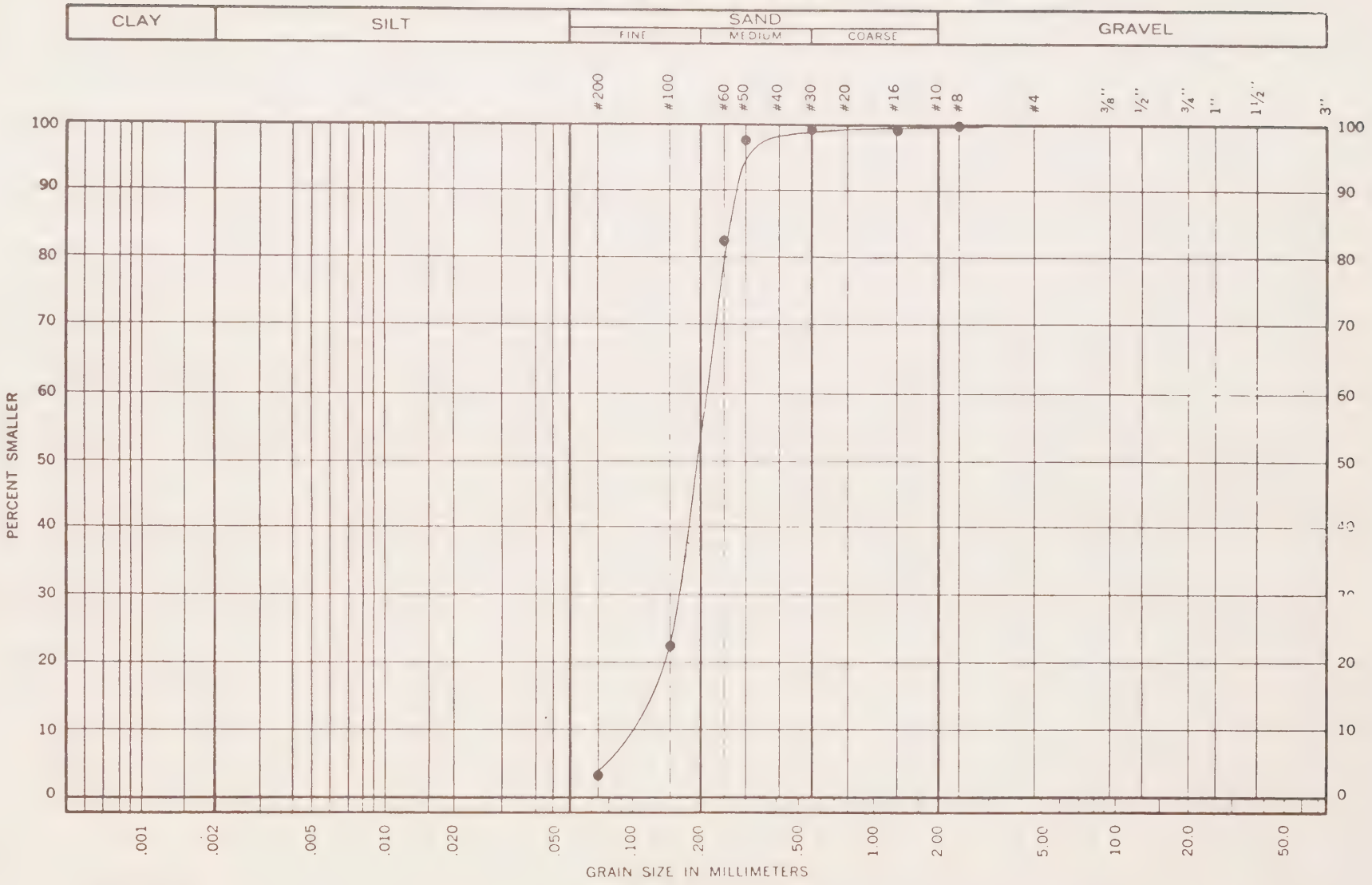
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION CL - CH
Clayey Silt

PROJECT Ft. Simpson Subdivision
JOB No. E-498 DATE SEPT 6/72
SAMPLE No. TH #1
DEPTH 12'

FIGURE 15

GRAIN SIZE DISTRIBUTION

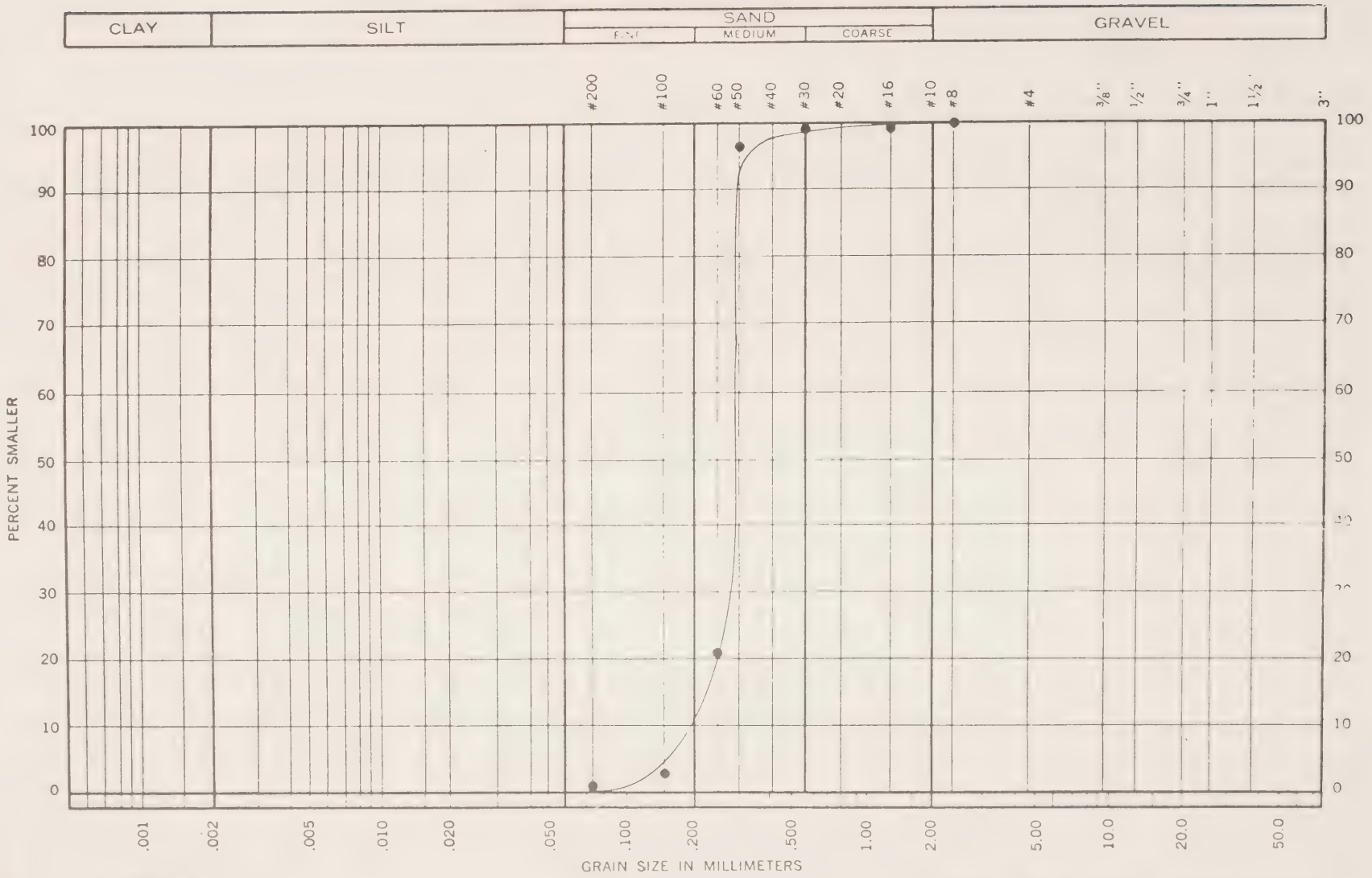


BROOKER & ASSOCIATES

SAMPLE DESCRIPTION SP
Poorly Graded Clean Sand

PROJECT Ft. Simpson Subdivision
JOB No. E-498 DATE SEPT. 6/72
SAMPLE No TH #2
DEPTH 6.8'

GRAIN SIZE DISTRIBUTION



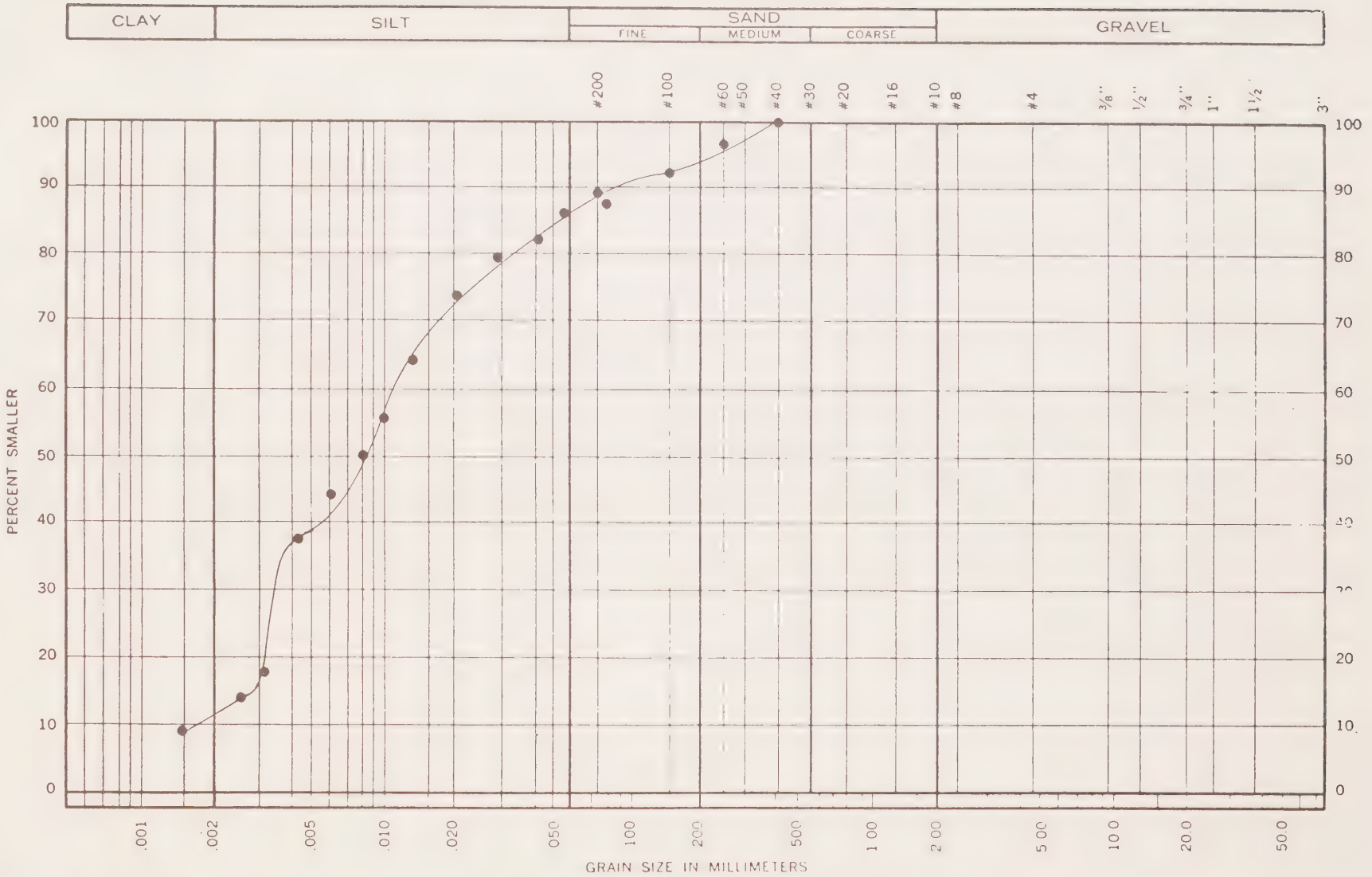
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION SP
Poorly Graded Clean Sand

PROJECT Ft. Simpson Subdivision
JOB No E-95 DATE [illegible]
SAMPLE No. TH #3
DEPTH 5'

FIGURE 17

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

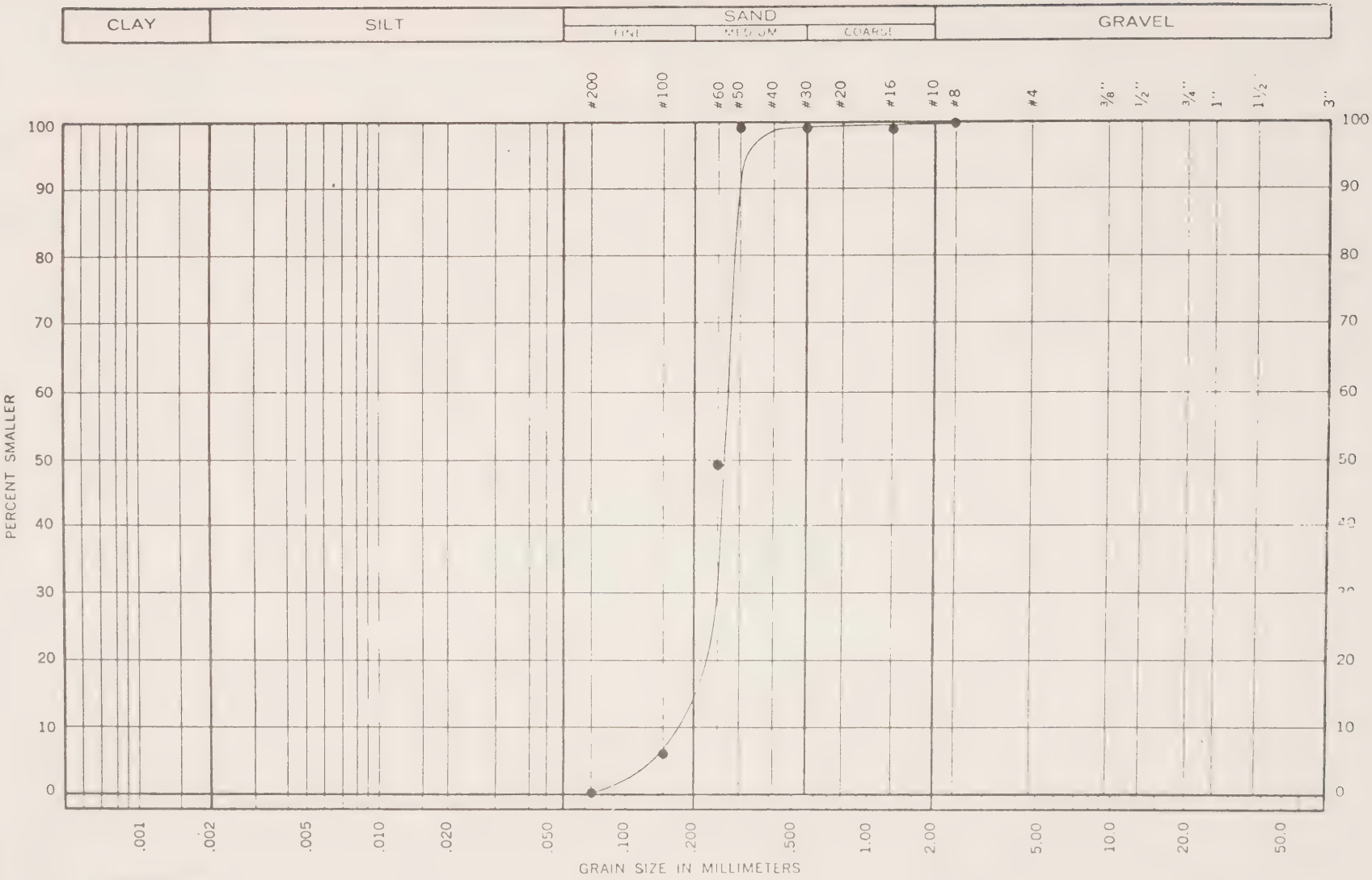
SAMPLE DESCRIPTION ML
Silt - some sand & clay

PROJECT Ft Simpson Subdivision
JOB No. E-498 DATE Sept 2/22
SAMPLE No. TH #3A
DEPTH 2.5'

FIGURE 8

110

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

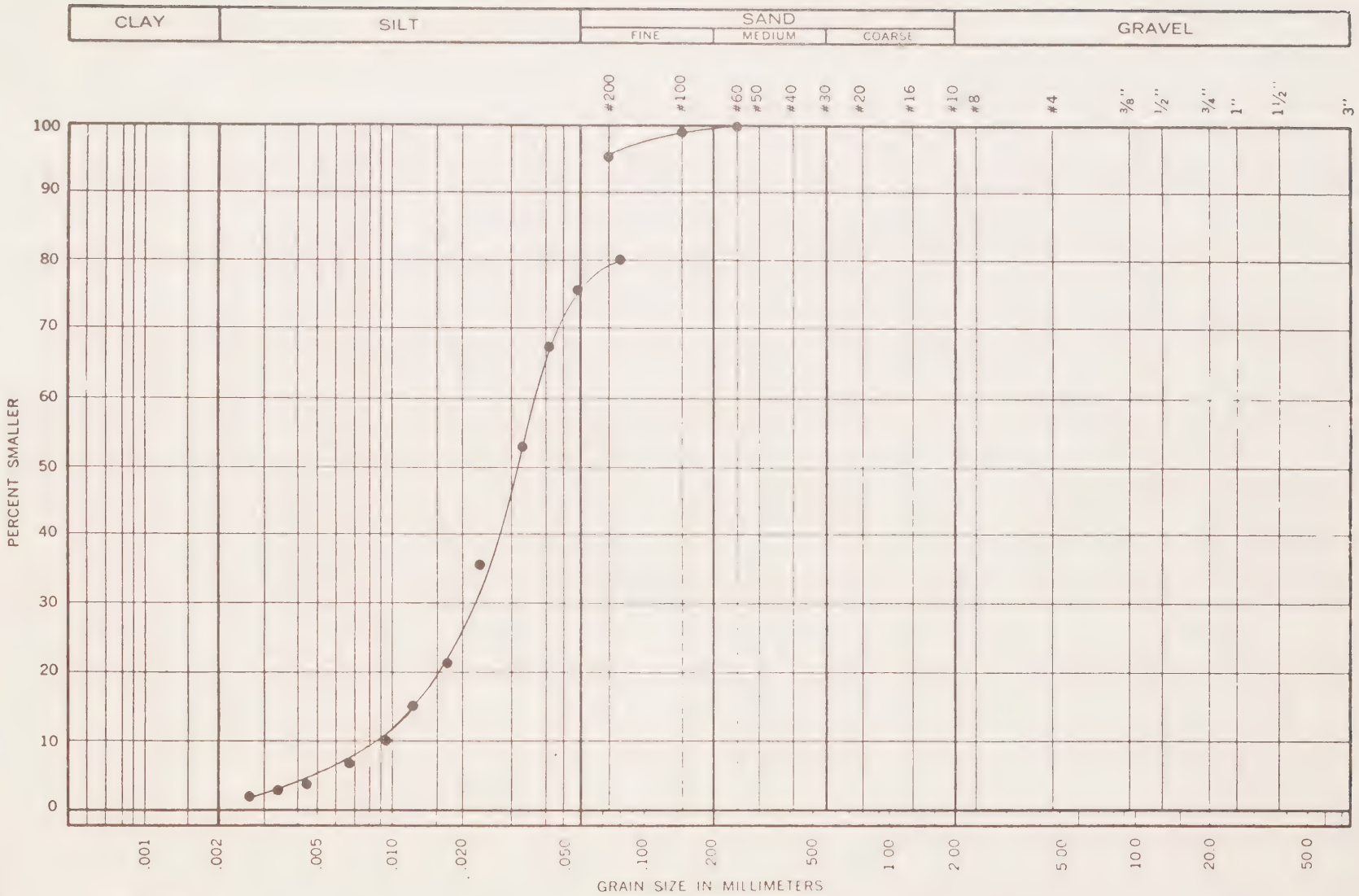
SAMPLE DESCRIPTION SP
Poorly Graded Sieve Sand

PROJECT Ft Simpson Subdivision
JOB No E-498 DATE SEPT 6/78
SAMPLE No. TH#11
DEPTH 3'

FIGURE 19

111

GRAIN SIZE DISTRIBUTION



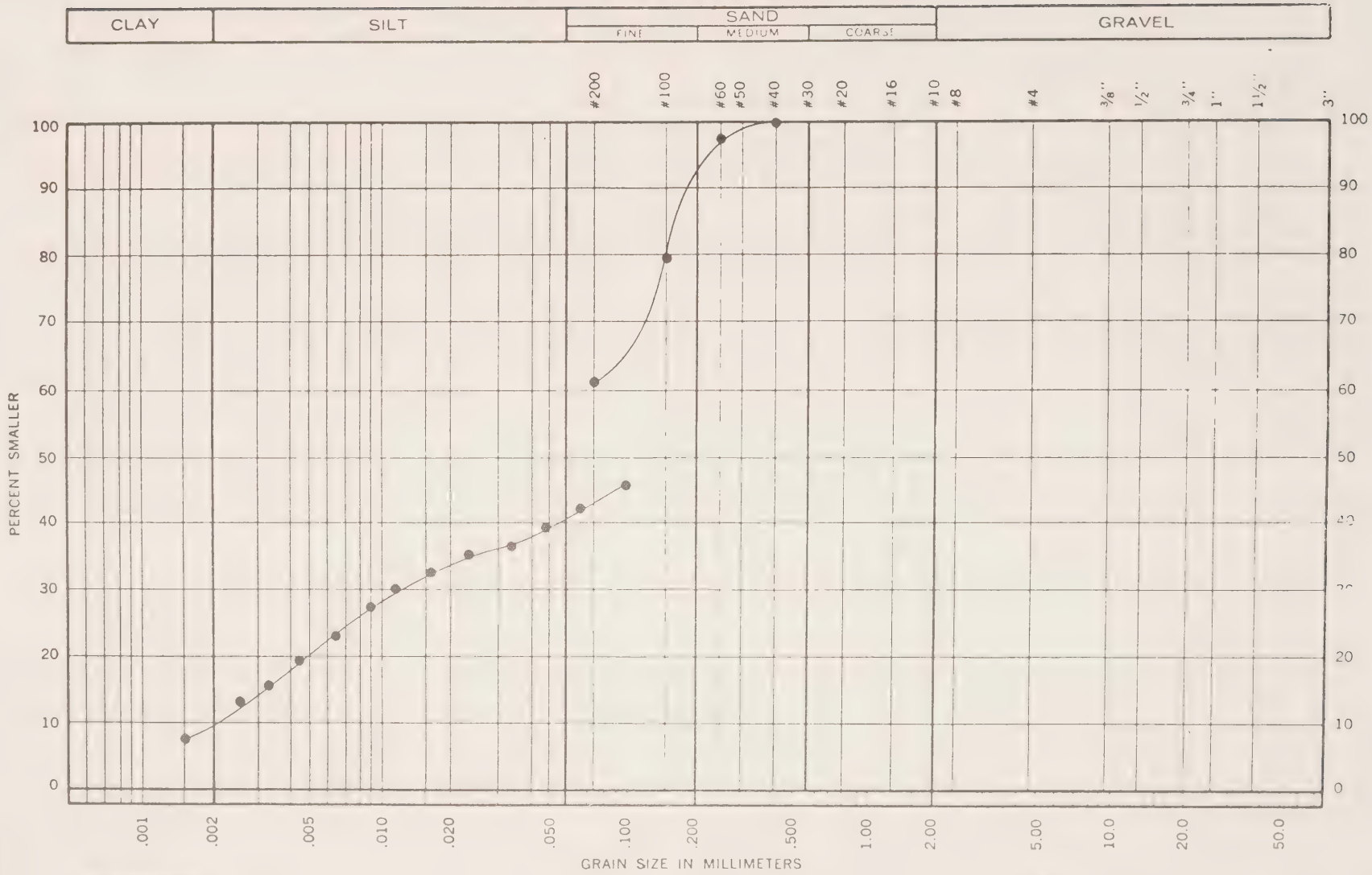
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION ML
Sandy Silt

PROJECT Ft. Simpson Subdivision
JOB No. E-498 DATE SEPT. 9/72
SAMPLE No. TH #5
DEPTH 12'

FIGURE 20

GRAIN SIZE DISTRIBUTION



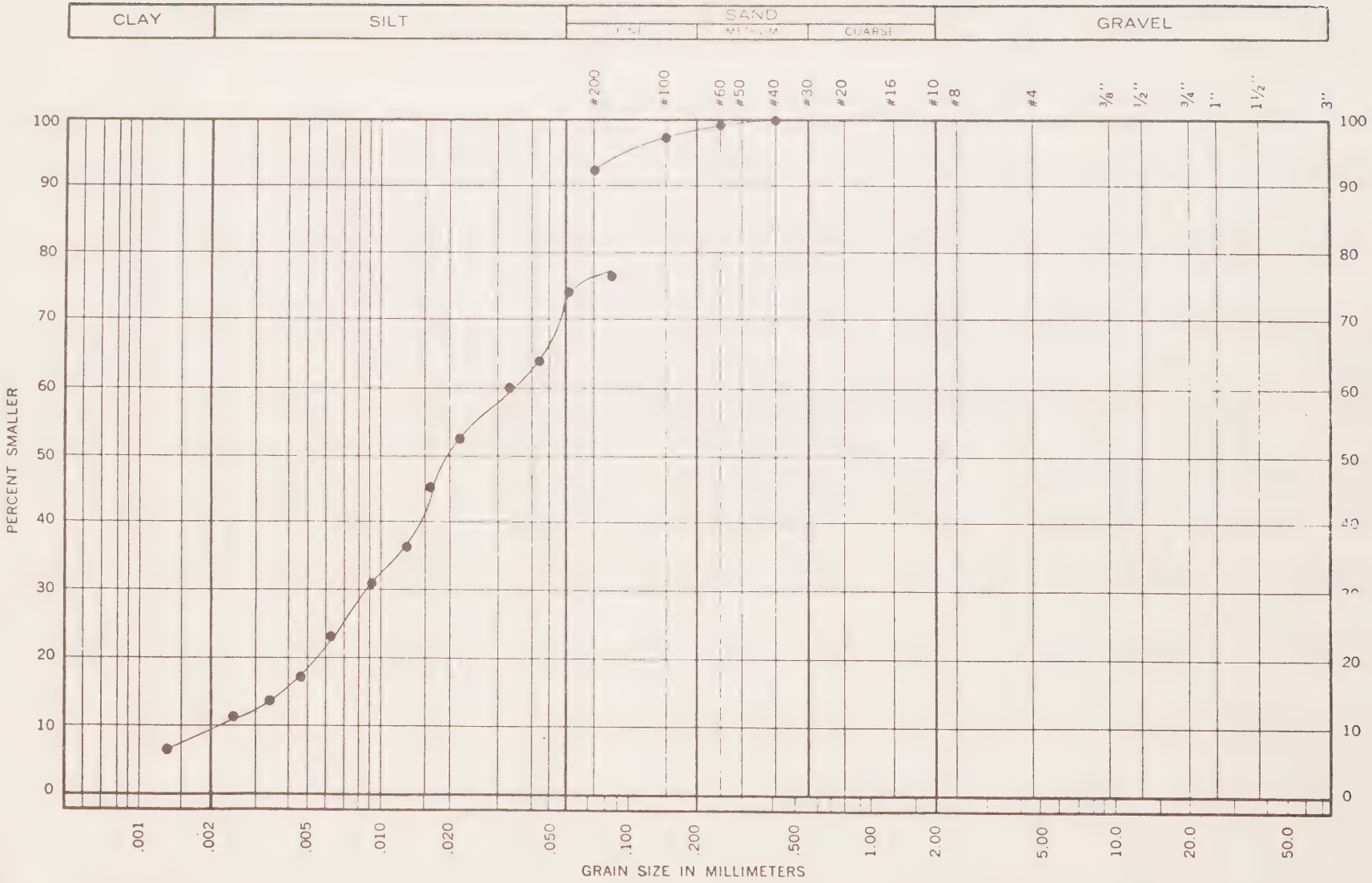
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION ML: SF Sandy Silt

PROJECT I I Simpson Subdivision
JOB No. E-498 DATE SEPT. 7/72
SAMPLE No. TH. # 8
DEPTH 3'

FIGURE 2.1

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

SAMPLE DESCRIPTION ML
Sandy Silt

PROJECT FT. SIMPSON SUBDIVISION
JOB No. E-498 DATE SEPT. 6/72
SAMPLE No. TH# 10
DEPTH 6'

FIGURE 22

PROJECT	Fort Simpson Subdivision	TESTHOLE No. 1B
SURFACE ELEVATION		JOB No. E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SILT medium brown, fine sandy, some clay, low plasticity, moist, soft		
4		▽	
6	SAND medium brown, silty, medium grained, wet		
8			
10	CLAY grey, some silt, medium to high plasticity, frozen, some ice crystals to bottom of hole	FROST	
12		⊢—⊣	
14			
16			
18	END OF HOLE NOTE: Soil frozen from 9.5'.		

Completion Depth 17' Date Sept 7/72

Depth to Water in Boring 4.5' on Completion

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 23

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	2B
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
	SAND medium brown, some silt, medium grained, medium dense, moist		
2			
4			
6			
8			
10	green, medium to coarse grained, medium dense, wet		
12		SLOUGH	
14			
16			
18			
20			
22	grey, medium to coarse grained, medium dense, wet		
24			
26	END OF HOLE		
	NOTE: Soil unfrozen for entire depth of hole. Hole sloughed into 12' on completion.		

Completion Depth	25.5'	Date	Sept 7/72	10 20 30 40 50
Depth to Water in Boring	Hole Sloughed Into 12'	Page	1 of 1	Penetration Resistance N
				Dwg. No. 24

PROJECT	Fort Simpson Subdivision	TESTHOLE No. 3B
SURFACE ELEVATION		JOB No. E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND grey-brown, moist, medium grained, medium dense		
4			
6			
8		SLOUGH	
10	grey, moist, medium grained, medium dense		
12			
14			
16	medium to coarse grained, wet		
18	SILT grey, some clay, wet		
20	grey, sandy, medium dense, wet, non plastic		
22			
24	CLAY grey, medium to high plasticity, moist, firm		
26	END OF HOLE		

NOTE: Soil unfrozen for entire depth of hole. Hole sloughed into 8' on completion.

Completion Depth 25.5' Date Sept 7/72

Depth to Water in Boring Hole Sloughed Into 8'

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 25

PROJECT	Fort Simpson Subdivision	TESTHOLE No. 4B
SURFACE ELEVATION		JOB No. E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND medium brown, fine to medium grained, medium dense, moist		
4			
6	grey, medium to coarse grained, medium dense, moist		
8		SLOUGH	
10	grey, wet fine to medium grained, medium dense		
12			
14			
16			
18			
20			
22			
24	CLAY grey, some silt, low plasticity, wet, soft		
26	END OF HOLE		
	NOTE: Soil unfrozen for entire depth of hole. Hole sloughed into 8' on completion.		

Completion Depth

Date Sept 7/72

Depth to Water in Boring: Hole Sloughed Into 8'

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 26

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	5B
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND medium brown, some silt, fine grained, medium dense, moist		
4			
6	grey, trace of silt, fine grained, wet	SLOUGH	
8			
10	medium dense		
12			
14			
16	SILT grey, sandy, fine grained, non plastic, moist		
18			
20			
22			
24	frozen	FROST	
	END OF HOLE		
	NOTE: Soil frozen at 24'. Hole sloughed into 5.5' on completion.		

Completion Depth 24' Date Sept 7/72

Depth to Water in Boring Hole Sloughed Into 5.5'

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 27

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	6B
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND orange-brown, silty, fine grained, moist, dense	FROST	
4	frozen from about 3'		
6			
8			
10	END OF HOLE		
	NOTE: Soil frozen from about 3'		

Completion Depth	10'	Date	Sept 7/72	10 20 30 40 50
Depth to Water in Boring	Dry	Page	1 of 1	Penetration Resistance N
				Dwg. No. 28

PROJECT Fort Simpson Subdivision

TESTHOLE No. 7B

SURFACE ELEVATION

JOB No. E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND medium brown, some silt, fine to medium grained, medium dense, moist		
4			
6	CLAY medium brown, silty, medium plastic, moist, firm		
8			
10	frozen grey, some silt, medium to high plasticity, moist, stiff	FROST	
12			
14			
16			
18	ice crystals		
20	ice crystals		
22			
24			
26	ice crystals		
	END OF HOLE		
	NOTE: Soil frozen from 11'		

Completion Depth 26' Date Sept 7/72

Depth to Water in Boring Dry

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 29

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	8B
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND dark brown, silty, some clay, fine grained, moist		
4			
6	CLAY grey, some silt, medium to high plasticity, moist, stiff		
8	frozen, unable to penetrate with auger	FROST	
10	END OF HOLE		

Completion Depth 9' Date Sept 8/72

Depth to Water in Boring Dry Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 30

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	9B
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
2	SAND medium brown, silty, fine grained, moist, medium dense
4	
6	
8	
10	CLAY grey, trace of silt, highly plastic, moist, firm
12	stiff
14	
16	
18	silty, low plasticity, soft, wet
20	
22	
24	
26	END OF HOLE

NOTE: Hole sloughed into 9' on completion.

Water Content % — 10 20 30 40

SLOUGH

Compressive Strength tsf. — 1 2 3 4 5

10 20 30 40 50

Penetration Resistance N

Completion Depth 25.5' Date Sept 8/72

Depth to Water in Boring Hole Sloughed Into 9'

Page 1 of 1

Dwg. No. 31

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	10B
SURFACE ELEVATION	-	JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND medium brown, some silt, fine to medium grained, wet, loose	SLOUGH	
4			
6			
8	grey frozen at 9'	FROST	
10	END OF HOLE NOTE: Hole sloughed into 2.5' on completion.		

Completion Depth 9' Date Sept 8/72

Depth to Water in Boring Hole Sloughed Into 2.5'

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 32

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	11B
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % 10 20 30 40	Compressive Strength tsf. 1 2 3 4 5
2	SAND medium brown, some silt, fine grained, moist, medium dense	FROST	
4	grey, frozen from 3.0'		
6			
8			
10			
12	END OF HOLE		

Completion Depth 12' Date Sept 8/72

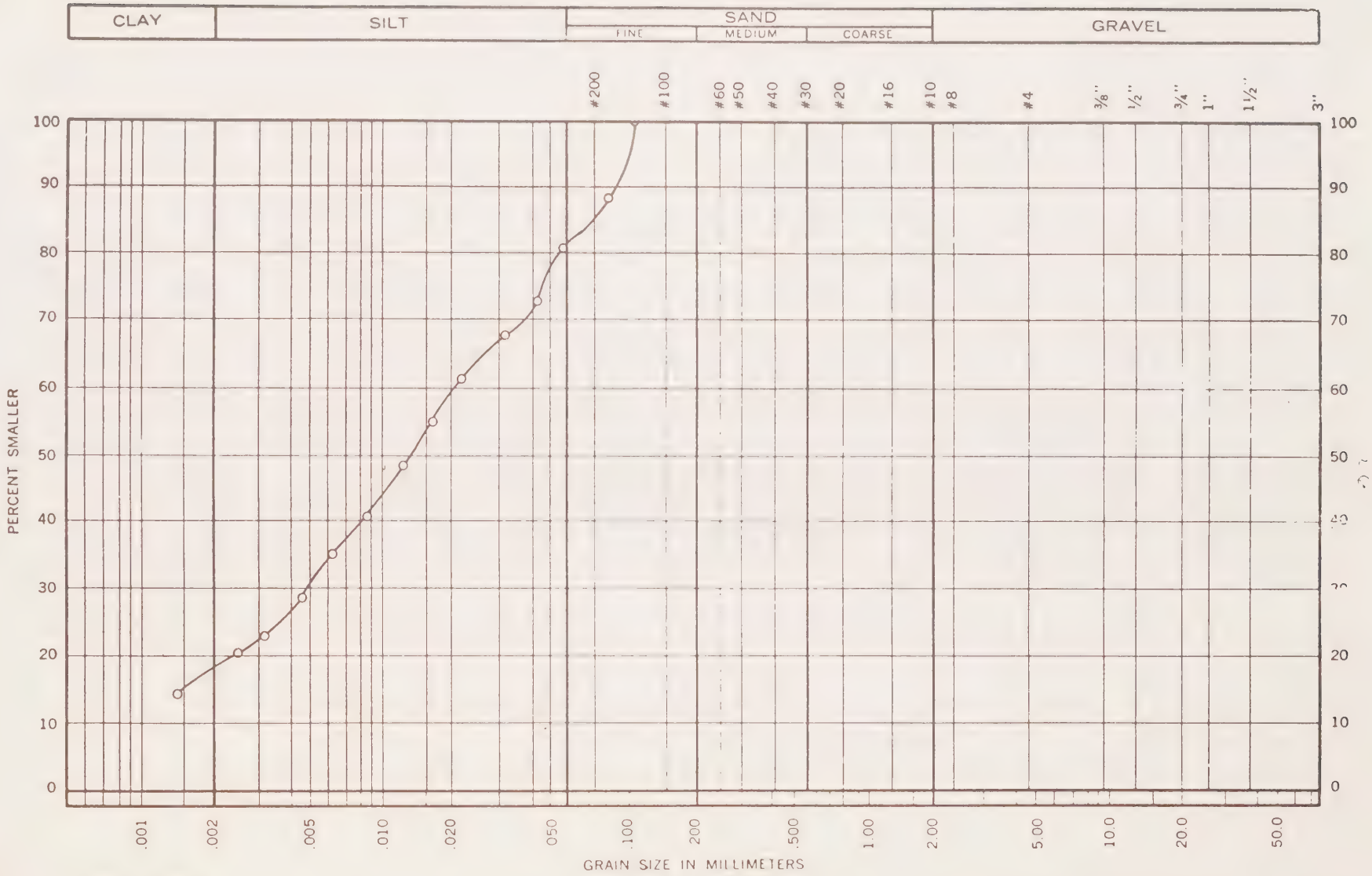
Depth to Water in Boring Dry Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 33

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

SAMPLE DESCRIPTION CL-ML
SILT — SOME CLAY & SAND

PROJECT FT. SIMPSON SUBDIVISION
JOB No E498 DATE 22/9/72
SAMPLE No. TH No. 18
DEPTH 4'

FIGURE 34

GRAIN SIZE DISTRIBUTION

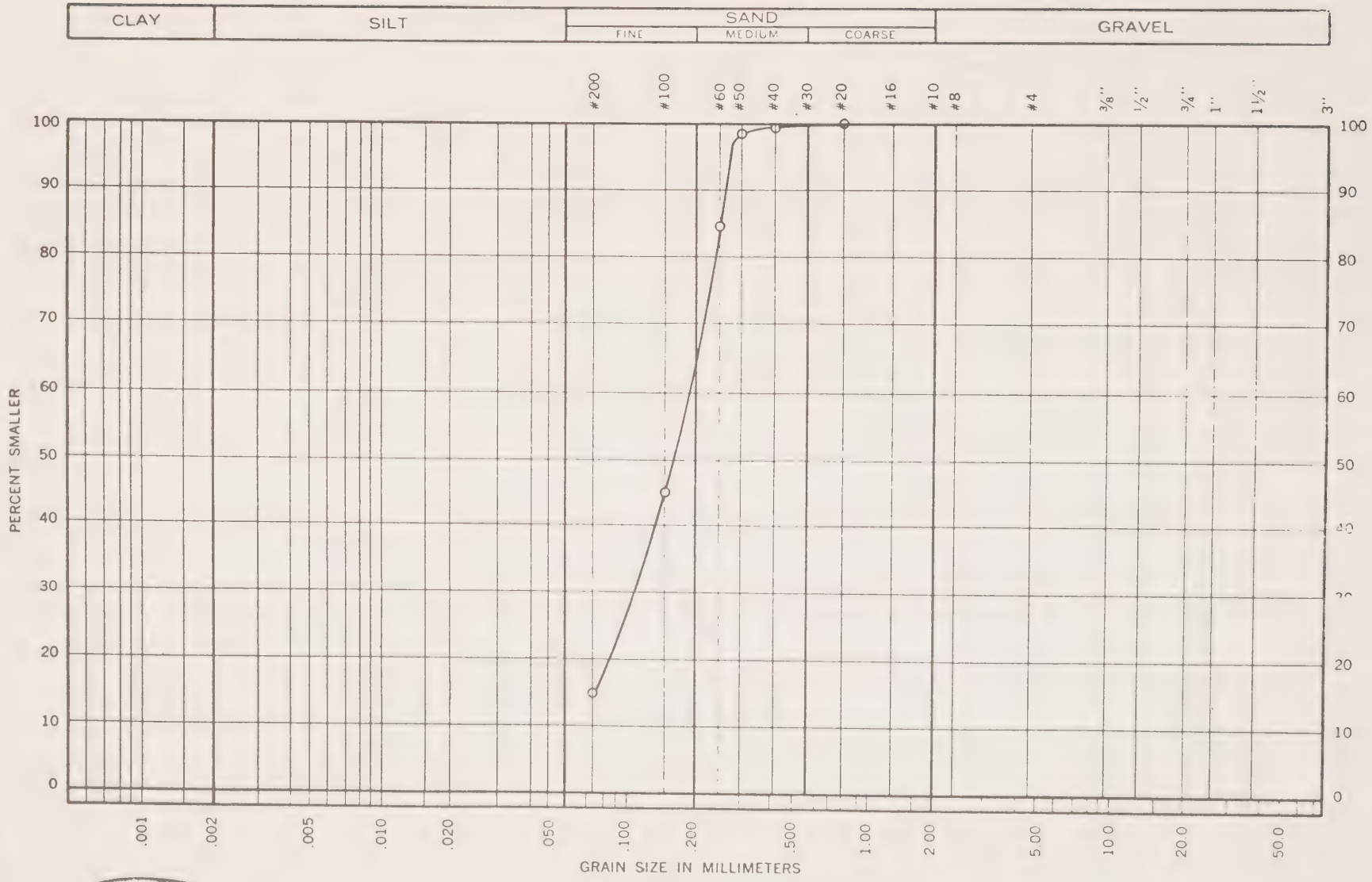


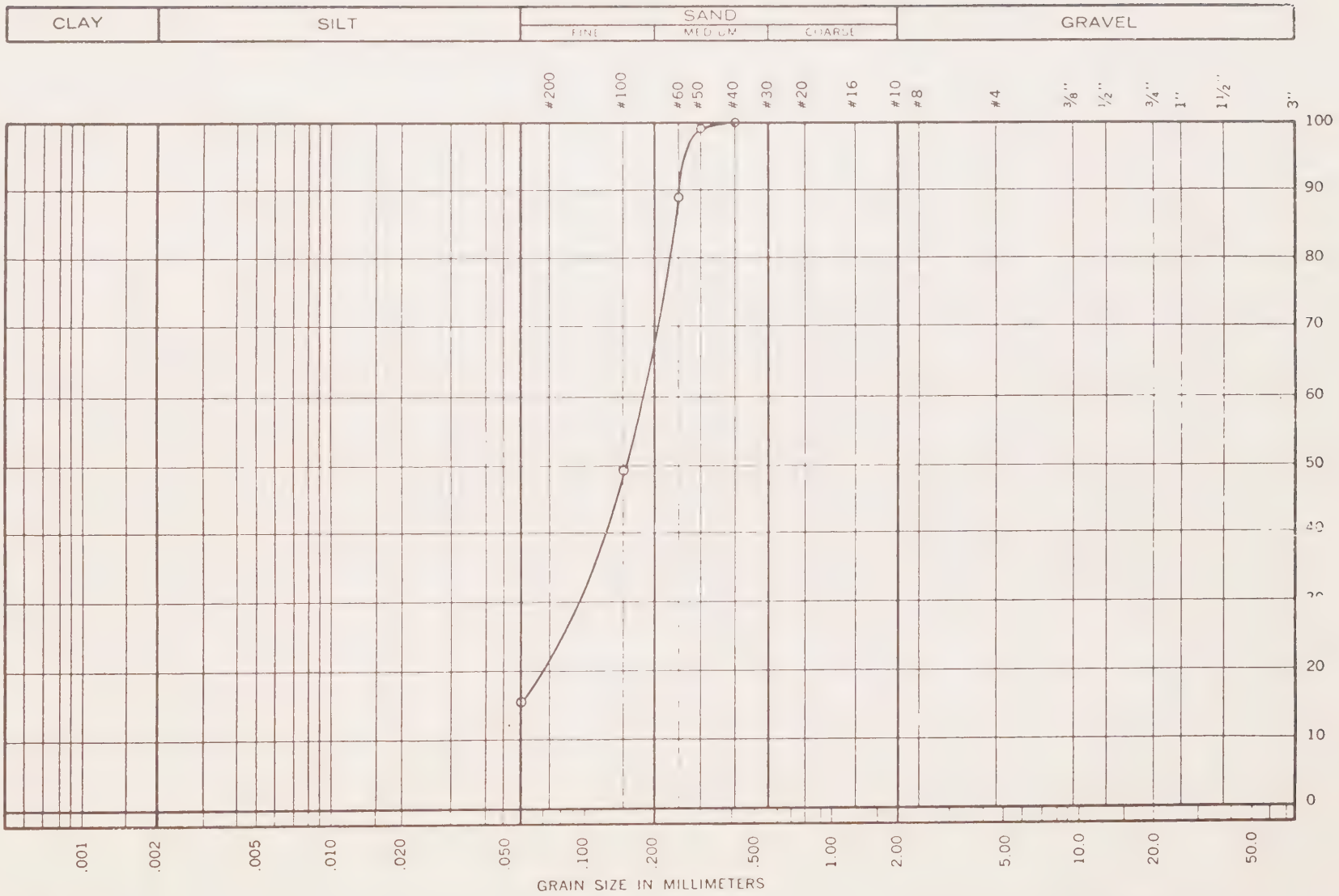
FIGURE 35

BROOKER & ASSOCIATES

SAMPLE DESCRIPTION S.P.
POORLY GRADED SAND - SOME SILT

PROJECT FT. SIMPSON SUBDIVISION
JOB No. E498 DATE 22/9/72
SAMPLE No. TH 5B
DEPTH 8'

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

SAMPLE DESCRIPTION SP
POORLY GRADED SAND — SOME SILT

PROJECT FT. SIMPSON SUBDIVISION
JOB No. E 498 DATE 22/9/72
SAMPLE No. TH-11B
DEPTH 6'

FIGURE 36

SUMMARY OF TEST RESULTS

JOB No. E - 498

TEST HOLE	DEPTH	NATURAL WATER CONTENT	Atterberg Limits			MECHANICAL ANALYSIS (M.L.T. CLASSIFICATION)				SPECIFIC GRAVITY	ORGANIC CONTENT %	DRY DENSITY PCF	STRATA CLASSIFICATION
			W_L	W_P	PI								
	feet	%	%	%	%	% CLAY	% SILT	% SAND	%GRAVEL				
1	6					0	0	100	0				SP
	17					38	62	0	0				CL - CH
2	6.8					0	0	100	0				SP
3	5.4					0	0	100	0				SP
3A	2.5					12	74	14	0				ML
4	6					0	0	100	0				SP
5	12					0	85	15					ML
8	3					10	40	50	0				ML - SF
10	6					9	71	20	0				ML

SUMMARY OF TEST RESULTS

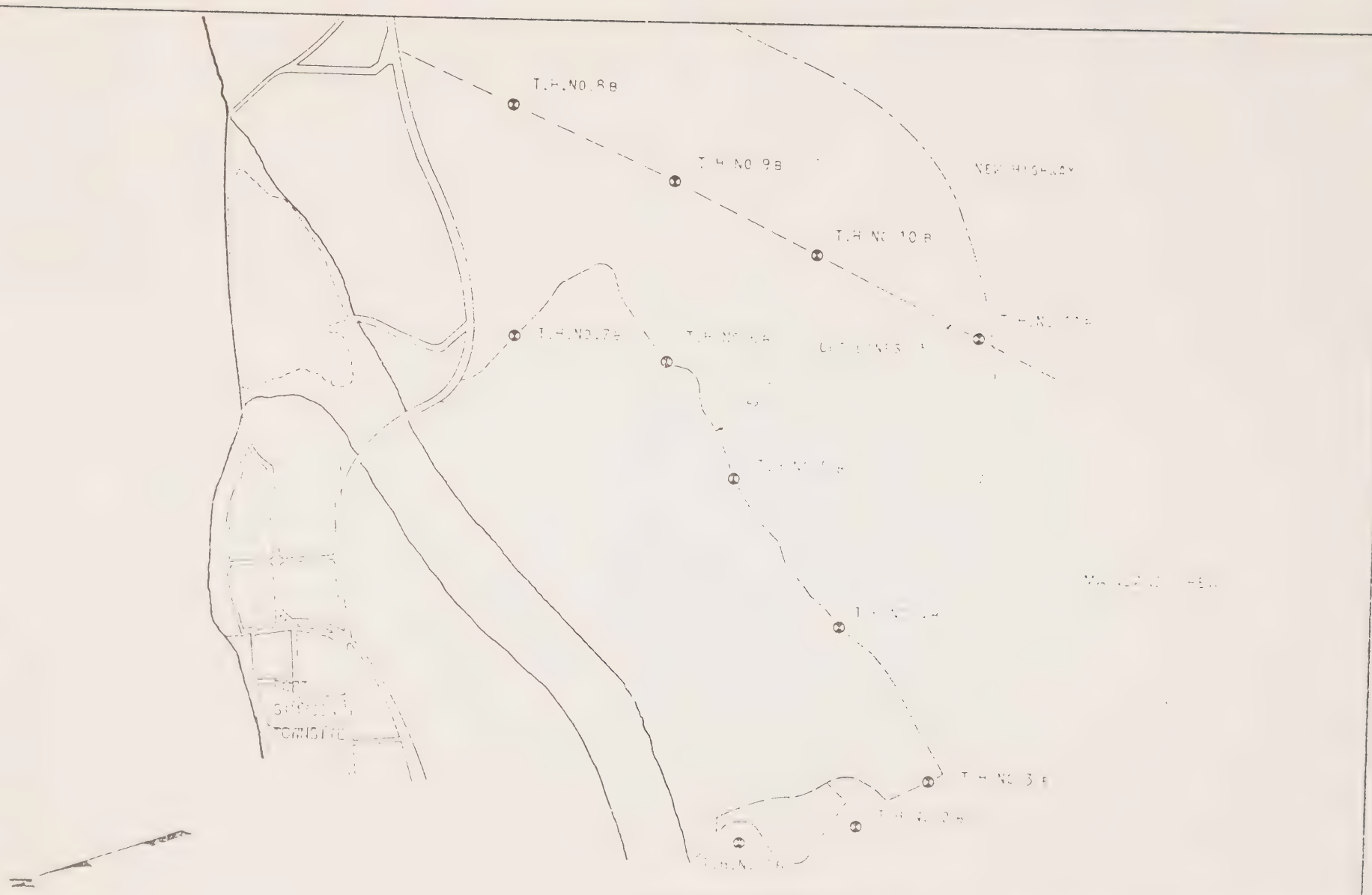
JOB No. E - 490

TEST HOLE	DEPTH	NATURAL WATER CONTENT	Atterberg Limits			MECHANICAL ANALYSIS (M.L.T. CLASSIFICATION)				SPECIFIC GRAVITY	ORGANIC CONTENT %	DRY DENSITY PCF	STRATA CLASSIFICATION
			W_L	W_P	PI								
	feet	%	%	%	%	% CLAY	% SILT	% SAND	%GRAVEL				
1-B	4												
	12		33.6	17.1	16.5	18	63	19	0				CL - ML
5-B	8					0	8	92	0				SP
7-B	8		38.5	18.4	20.1								CL
9-B	12		28.4	13.8	14.6								CL
11-B	6					0	15	85	0				SP

130

E. W. CROCKER & ASSOCIATES LTD.

Drwg. No. 37b


T.H.NO.8B
T.H NO 9B
T.H NO 10B
NEW HIGHWAY
T.H.NO.2B
T.H NO 3B

eba
consulting civil engineers

E.W. Brooker & Associates Ltd.
11738, Kingsway Avenue, Edmonton 19, Alberta
phone (403) 453-3665

October 2, 1972

W. J. Francl & Associates Ltd.
204 11445 - 124 Street
Edmonton, Alberta

Attention: Mr. J. Patterson, P. Eng.

Gentlemen:

Subject: Proposed Fort Simpson Subdivision Development - Fort Simpson, N.W.T.

At the request of Mr. J. Patterson, P. Eng., of W. J. Francl & Associates, additional field drilling was carried out, near the Town of Fort Simpson, in conjunction with the subject development. The field drilling was carried out on September 27, 1972, using a rotary drill rig mounted on a tracked carrier. Four borings were drilled, in the CMHC area, in the approximate locations shown on Drawing No. 1, attached.

Following is a summary of the generalized stratigraphy noted in the area in which the boreholes were drilled. Detailed borehole logs are included as Drawings No. 2 to 5, inclusive,and grain size distribution curves are presented as Drawings No. 6 to 9, inclusive.

	Material Description	Average Depth Below Grade (ft)	Range of Thickness (ft)
SAND	medium brown changing to grey brown to grey with depth, silty, fine, medium & coarse grained, wet to very wet with depth	0 - Maximum Depth of Penetration	Not Established

In addition the following observations, which may have an influence on development and construction, were made:

1. The maximum depth of borehole penetration was 20.5 feet.

2. Although no water levels were recorded, wet to very wet sand was noted in all boreholes at depths ranging from about 5.5 to 13 feet below existing grade. Severe sloughing conditions were encountered in Borehole TH2C at a depth of about 11.5 feet below existing grade.

3. Frozen soil was not noted in any of the boreholes.

The area in which the boreholes were drilled consists of gently undulating topography dissected by several creek gulleys up to 20 feet in depth. Tree cover consists predominantly of spruce and poplar. Surficial drainage in the area range from fair to good, depending on local terrain conditions.

II. OBSERVATIONS AND CONCLUSIONS

The following observations and conclusions are presented covering the subsoil conditions in the CMHC site, in which Boreholes TH1C to TH4C, inclusive, were drilled.

2.1 The subsurface soil, within the depth of investigation consists of a moderately frost susceptible, silty, fine, medium and coarse grained sand. The sand was noted to be wet to very wet from depths ranging from 5.5 to 13 feet below existing grade. No frozen soil conditions were noted in any of the boreholes.

2.2 Based on observations of subsoil conditions at the site, it is believed that housing development within the area is feasible. The subsoils are believed, with adequate foundation design procedures, to provide suitable support for structures. Depending on local subsurface moisture conditions and expected depth of frost penetration, it is believed that either spread foundations or pile foundations may be used within the area to support foundation loads. Choice of a foundation type and design of the foundation system should be based on a detailed foundation investigation within the area of consideration.

2.3 Although frozen ground was not encountered in the exploratory boreholes the proximity of wet soil conditions to the surface (5.5 to 13 foot depth) is expected to present some difficulties in installation of utilities and services below this depth. Severe sloughing was encountered in Borehole TH2C at a depth of about 11.5 feet.

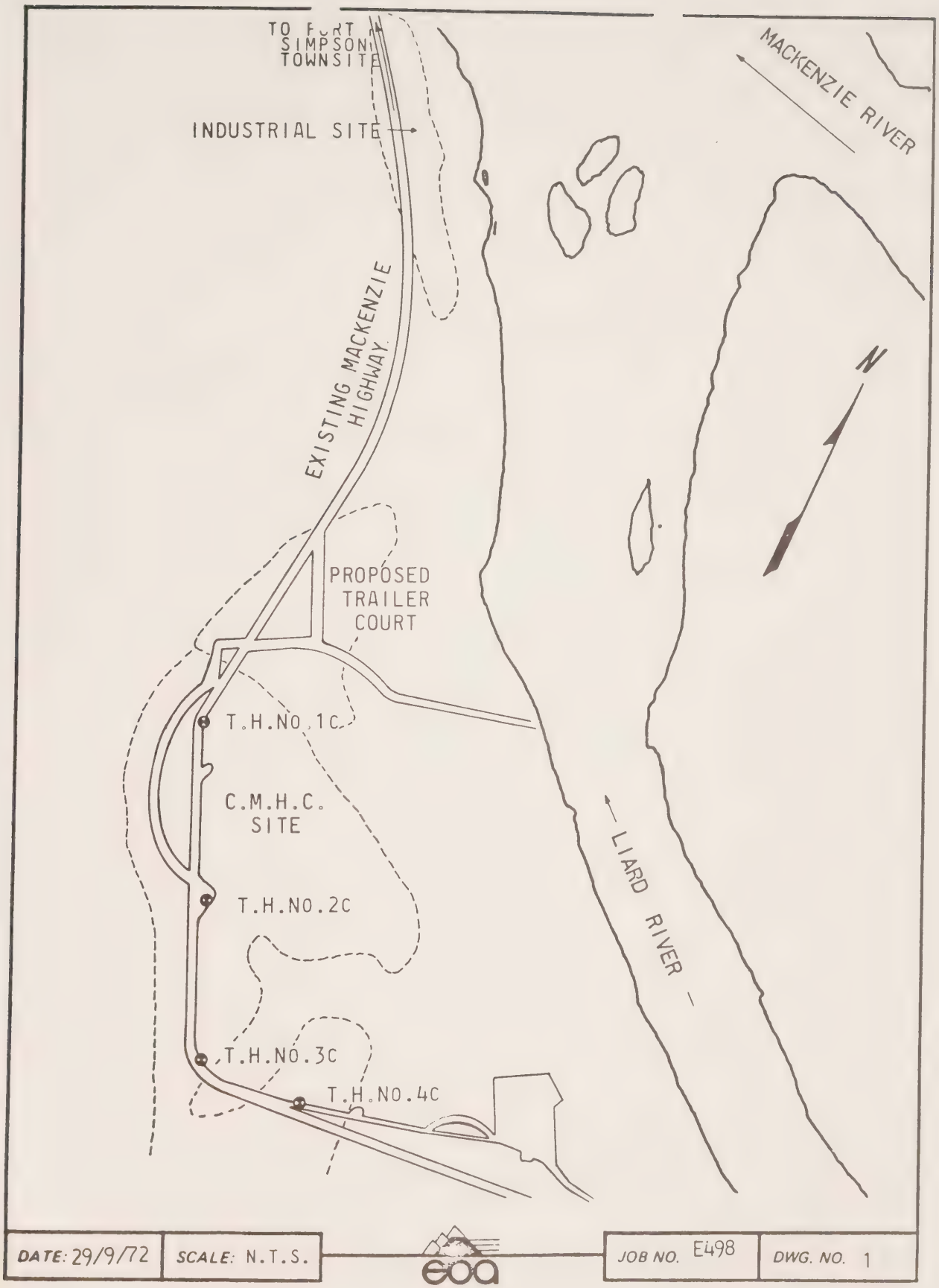
The foregoing information is presented, based on the geotechnical evaluation of findings in four boreholes drilled within the CMHC site. The conditions noted in the borings were generally similar and are believed representative of the entire site.

We trust that the foregoing report meets your present requirements. Should you have any questions, please contact our office.

Yours very truly,

ELMER W. BROOKER & ASSOCIATES LTD.

Lawrence A. Balanko, P. Eng.
LAB:sjw


TO FORT SIMPSON TOWNSITE
INDUSTRIAL SITE
MACKENZIE RIVER
EXISTING MACKENZIE HIGHWAY
N
PROPOSED TRAILER COURT
T.H.NO.1C
C.M.H.C. SITE
T.H.NO.2C
T.H.NO.3C
T.H.NO.4C
LIARD RIVER
DATE: 29/9/72
SCALE: N.T.S.
eda
JOB NO. E498
DWG. NO. 1

PROJECT Fort Simpson S Division

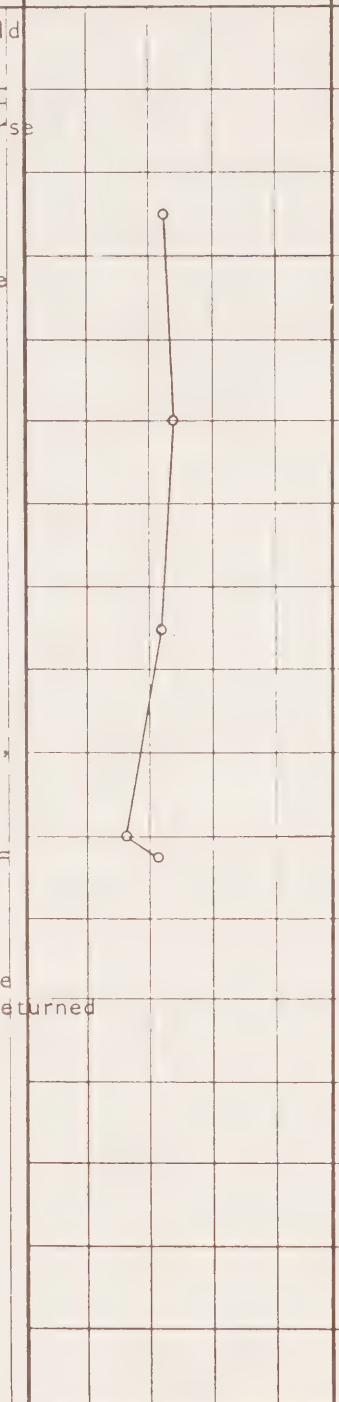
TESTHOLE No. TH1C

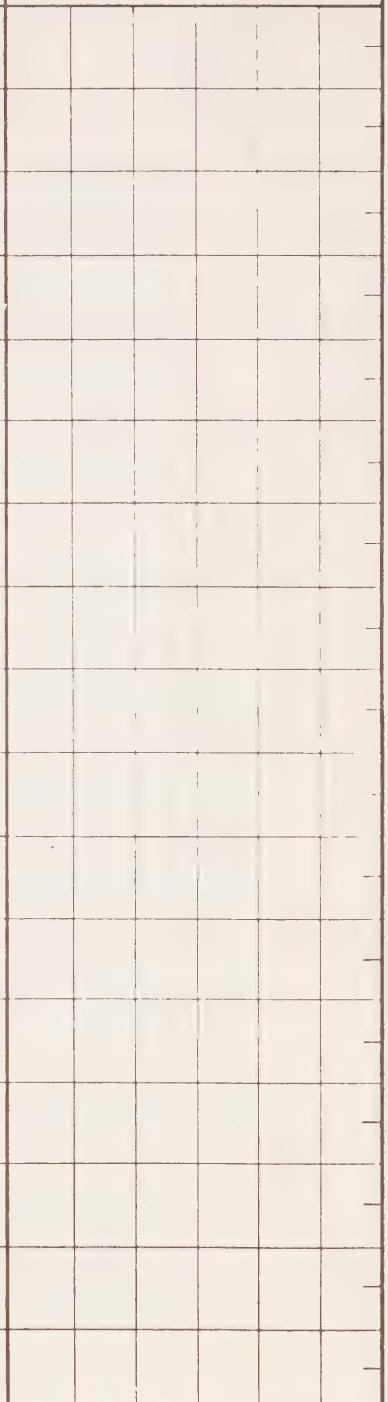
SURFACE ELEVATION

JOB No. E - 498

Depth ft.	SOIL DESCRIPTION
	SAND medium brown, silty, could be fill
2	PEAT dark brown
	SAND medium brown, silty, coarse
4	
6	wet dark brown, silty, coarse
8	
10	
12	
14	medium to dark brown
16	
18	medium grey brown, silty, coarse, very wet
20	medium grey, sandy silty clay, some pebbles
22	END OF HOLE

NOTE: Hole drilled with a three blade bit and cuttings returned by air





Completion Depth 20.5' Date Sept 27/72

Depth to Water in Boring Not Determined

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 2

PROJECT	Fort Simpson S division	TESTHOLE No.	TH2C
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	SAND medium brown, silty
2	grey brown, silty, fine to medium grained
4	
6	
8	grey brown, silty, medium to coarse grained, some small pebbles
10	very wet
	hole sloughing, no cuttings returned
12	
14	
16	very wet
18	
20	medium grey sandy silty clay
	END OF HOLE
	NOTE: Hole drilled with a three blade bit and cuttings returned by air

Water Content % o
10 20 30 40

Compressive Strength tsf.
1 2 3 4 5

10 20 30 40 50
Penetration Resistance N

Completion Depth 20.0' Date Sept 27/72

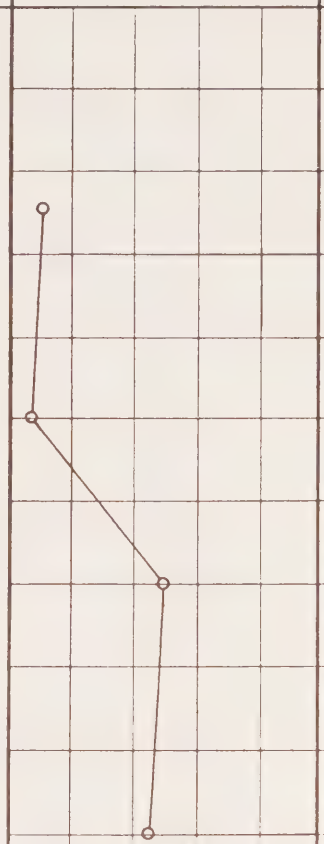
Depth to Water in Boring Not Determined

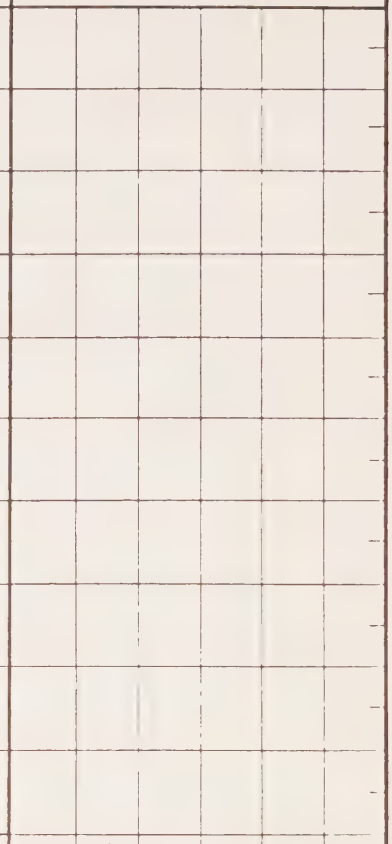
Page 1 of 1

Dwg. No. 3

PROJECT	Fort Simpson . division	TESTHOLE No.	TH3C
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	SAND light brown, silty, some roots
2	
	medium brown, silty, fine grained
4	
6	
8	grey-brown, silty
10	
12	
14	wet
16	dark grey brown, coarse grained, very wet
18	
20	END OF HOLE
	NOTE: Hole drilled with a three blade bit and cuttings returned by air





Completion Depth 20.0' Date Sept 27/72

Depth to Water in Boring Not Determined Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 4

PROJECT Fort Simpson Subdivision

TESTHOLE No. TH4C

SURFACE ELEVATION

JOB No. E - 498

Depth ft.	SOIL DESCRIPTION
	SAND light to medium brown, silty, some gravel (possibly from road)
2	
4	medium grey-brown, silty, coarse grained
6	
8	
10	dark grey brown to grey, silty, coarse grained, wet
12	
14	
16	
18	medium grey-brown, silty, coarse grained
20	
	END OF HOLE
22	

NOTE: Hole drilled with a three blade bit and cuttings returned by air

Water Content % O
10 20 30 40

Compressive Strength tsf.
1 2 3 4 5

10 20 30 40 50
Penetration Resistance N

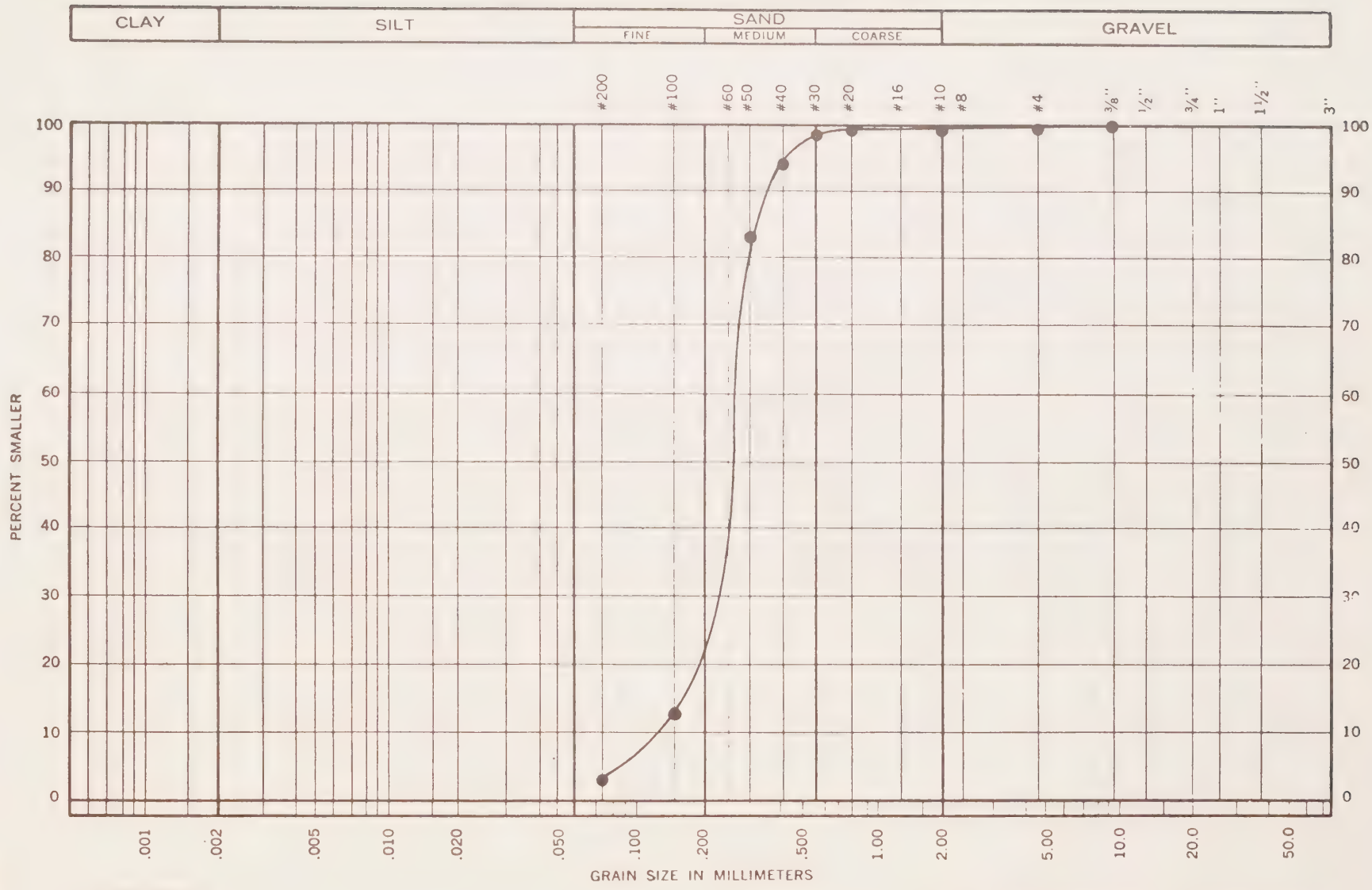
Completion Depth 20.0' Date Sept 27/72

Depth to Water in Boring Not Determined

Page 1 of 1

Dwg. No. 5

GRAIN SIZE DISTRIBUTION



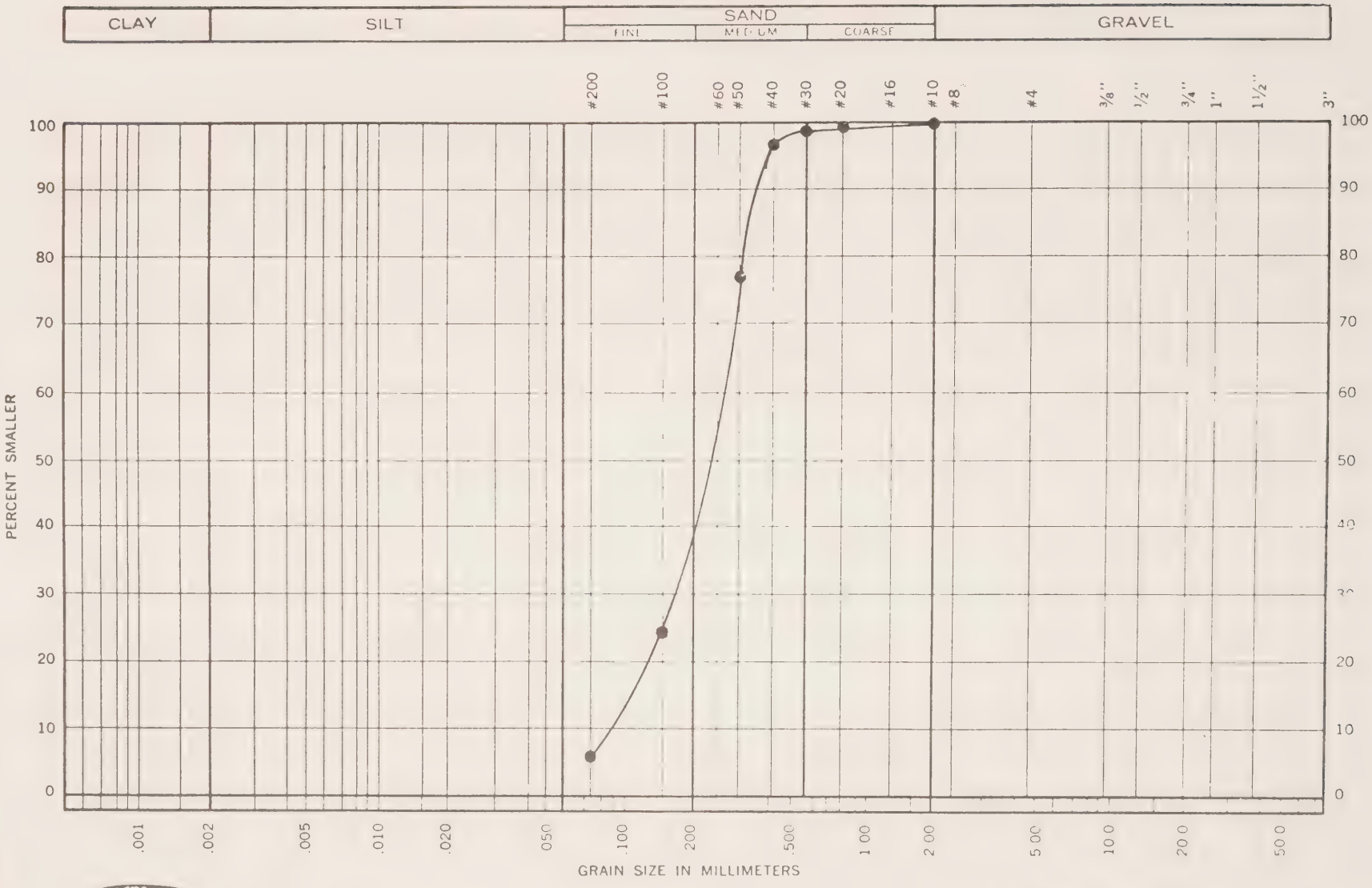
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION MEDIUM SAND

PROJECT Ft. SIMPSON SUBDIVISION
JOB No. E 498 DATE 2 OCT. 1972
SAMPLE No. 1
DEPTH 10'-0"

FIGURE 6

GRAIN SIZE DISTRIBUTION



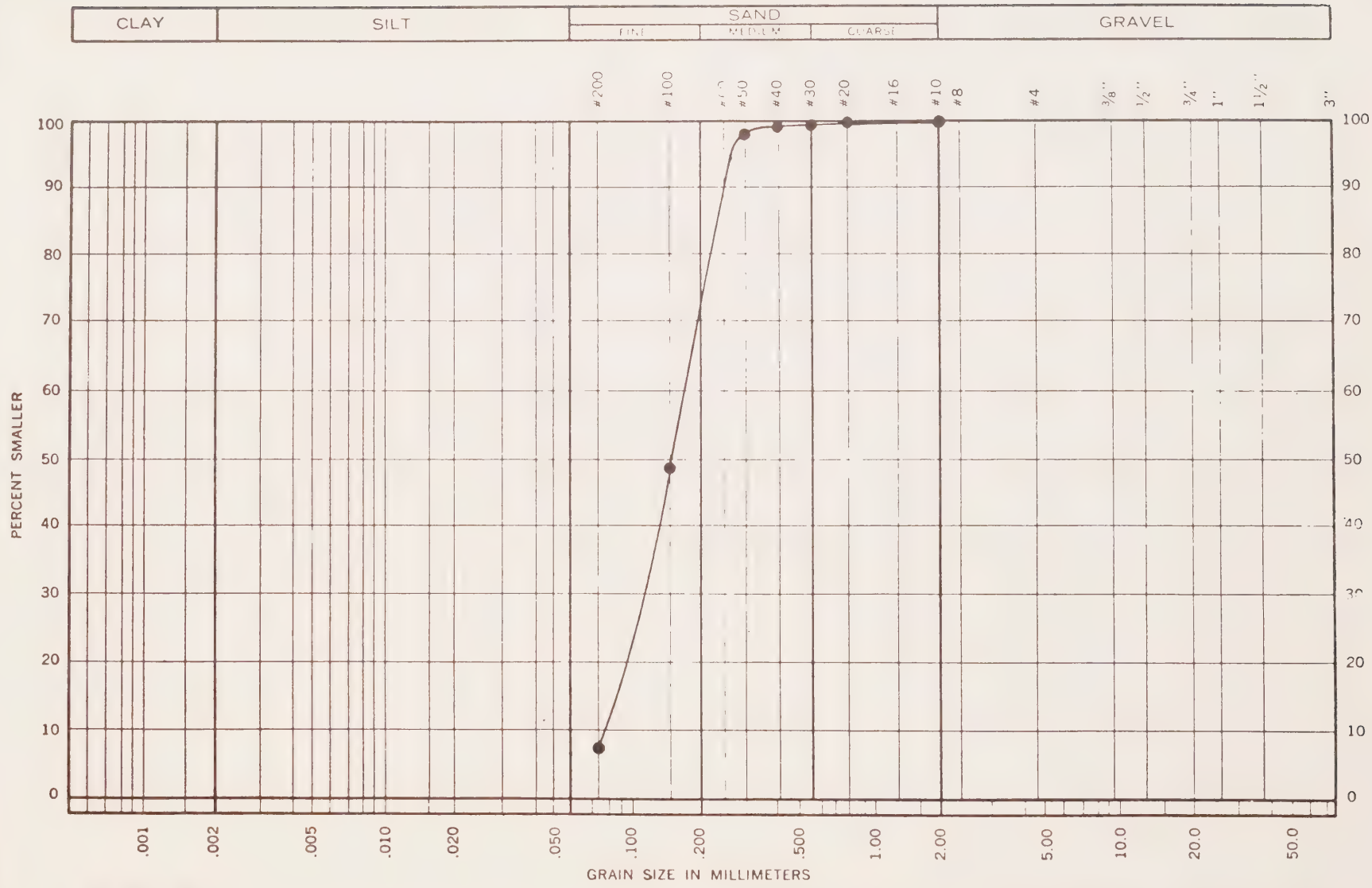
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION FINE TO MEDIUM SAND

PROJECT FT. SIMPSON SUBDIVISION
JOB No. E498 DATE 2 OCT. 1972
SAMPLE No. 2
DEPTH 5'-0"

FIGURE 7

GRAIN SIZE DISTRIBUTION



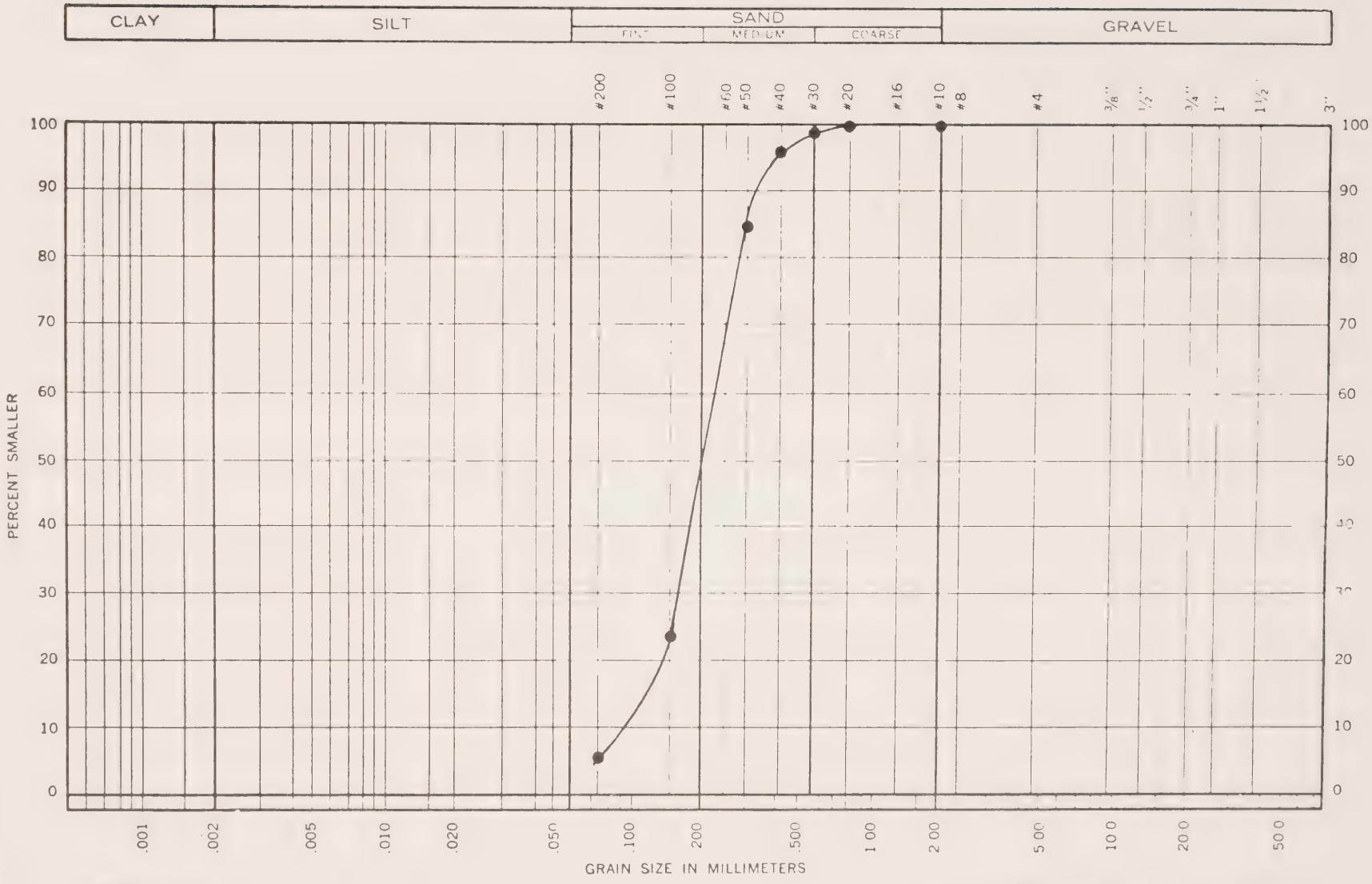
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION FINE SAND

PROJECT Ft. SIMPSON SUBDIVISION
JOB No. E498 DATE 2 OCT. 1972
SAMPLE No. 3
DEPTH 15'-0"

FIGURE 8

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

SAMPLE DESCRIPTION FINE TO MEDIUM SAND

PROJECT FT. SIMPSON SUBDIVISION
JOB No E498 DATE 2 OCT. 1972
SAMPLE No. 4
DEPTH 10'-0"

FIGURE 9

consulting civil engineers

L A Balanko, MSc P Eng
project engineer

October 17, 1972

W.J. Francl & Associates Ltd.,
204 11445 - 124 Street,
Edmonton, Alberta.

Attention: Mr. W.J. Francl, P.Eng.

Gentlemen:

Subject: Proposed Fort Simpson Subdivision Development - Fort Simpson, N.W.T.

At your request additional field drilling was carried out, near the Town of Fort Simpson, in conjunction with the subject development. The field drilling was carried out October 5, 6 and 7, 1972 using a truck mounted rotary drill rig. Twelve borings, 16 inches in diameter, were drilled in the approximate locations shown on Drawing No. 20 attached. Borehole locations were selected by Mr. J. Clark, of Clark Swanby & Associates Ltd., who was present during the field drilling program.

Following is a summary of the generalized stratigraphy noted in the area in which the boreholes were drilled. Detailed borehole logs are included as Drawings No. 1 to 12, inclusive and grain size distribution curves are presented as Drawings No. 13 to 19, inclusive.

	Material Description	Average Depth Below Grade (ft)	Range of Thickness (ft)
SAND	medium brown changing to grey brown to grey with depth, silty fine to medium grained, uniform moist to wet with depth	0 - Maximum Depth of penetration	Not Established

In addition the following observations, which may have an influence on development and construction, were made:

1. The maximum depth of borehole penetration was 20 feet.

E.W. Brooker & Associates Ltd. 11738, Kingsway Avenue, Edmonton 19, Alberta phone (403) 453-3665

2. Although a water level was recorded, only in Borehole 108, at a depth of 15 feet, wet sand was noted in most boreholes at depths ranging from about 6 to 16 feet below existing grade. Sloughing conditions, in moist sand, were encountered in most boreholes at a depth of about 2.0 feet below existing grade.

3. Frozen soil was noted in Borehole 101 and extended from a depth of about 2 feet to the maximum depth of penetration.

4. Boreholes 106 and 109 revealed a 4 foot thick, wet, sandy, silt stratum; existing at a depth of 5 and 8 feet, respectively.

The area in which the boreholes were drilled consists of undulating topography which slopes toward the Mackenzie River to the north. Tree cover consists predominantly of spruce and poplar. Surficial drainage in the area ranges from fair to good, depending on local terrain conditions.

II OBSERVATIONS AND CONCLUSIONS

The following observations and conclusions are presented covering the subsoil conditions in the site, in which Boreholes 101 to 112 inclusive, were drilled.

2.1 The subsurface soil, within the depth of investigation, consists generally of a moderately frost susceptible, silty, fine to medium grained sand. The sand was noted to be wet at depths ranging from about 6 to 16 feet below existing grade. Frozen soil conditions were noted only in Borehole 101, and extended essentially over the entire depth of penetration.

2.2 Based on observations of subsoil conditions at the site, it is believed that housing development within the area is feasible. The subsoils are believed, with adequate foundation design procedures, to provide suitable support for structures. Depending on local subsurface moisture conditions, expected depth of frost penetration, and depth of foundations and utilities, it is believed that spread foundations and/or pile foundations may be used within the area to support foundation loads. Choice of a foundation type and design of the foundation system should be based on a detailed foundation investigation within the area of consideration.

2.3 Although frozen ground was encountered in only one of the exploratory boreholes, the proximity of wet soil conditions to the surface (6 to 16 foot depths) is expected to present some difficulties in installation of utilities and services below this depth. Sloughing sand was encountered in almost all boreholes, at depths as near the surface as 1.5 feet, and is also expected to present difficulties in maintaining open excavations.

The foregoing information is presented, based on the geotechnical evaluation of findings in twelve boreholes drilled within the area investigated. The conditions noted in the borings were generally similar and are believed representative of the entire site.

We trust that the foregoing report meets your present requirements. Should you have any questions, please contact our office.

Yours very truly,

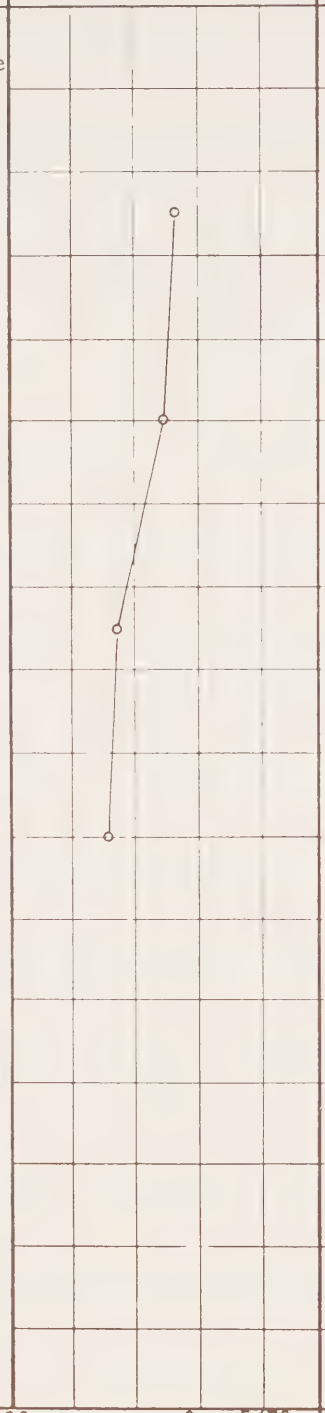
ELMER W. BROOKER & ASSOCIATES LTD.

Lawrence A. Balanko, P.Eng.
LAB:jt

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	101
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
2	SAND brown, fine, clean, uniform, frozen, visible ice crystals
4	coarser, uniform, grey, frozen, no visible ice, well bonded
6	
8	
10	fine to medium, uniform
12	
14	appeared to be unfrozen and wet, from 13' to 13½'
16	
18	frozen, visible ice crystals
20	END OF HOLE

NOTE: Hole appeared to be frozen to the maximum depth of penetration. Temperature ranged from 31.8°F to 32.2°F.





Completion Depth 20 Date Oct 5/72

10 20 30 40 50

Penetration Resistance N

Depth to Water in Boring No free water on completion

Page 1 of 1

Dwg. No. 1

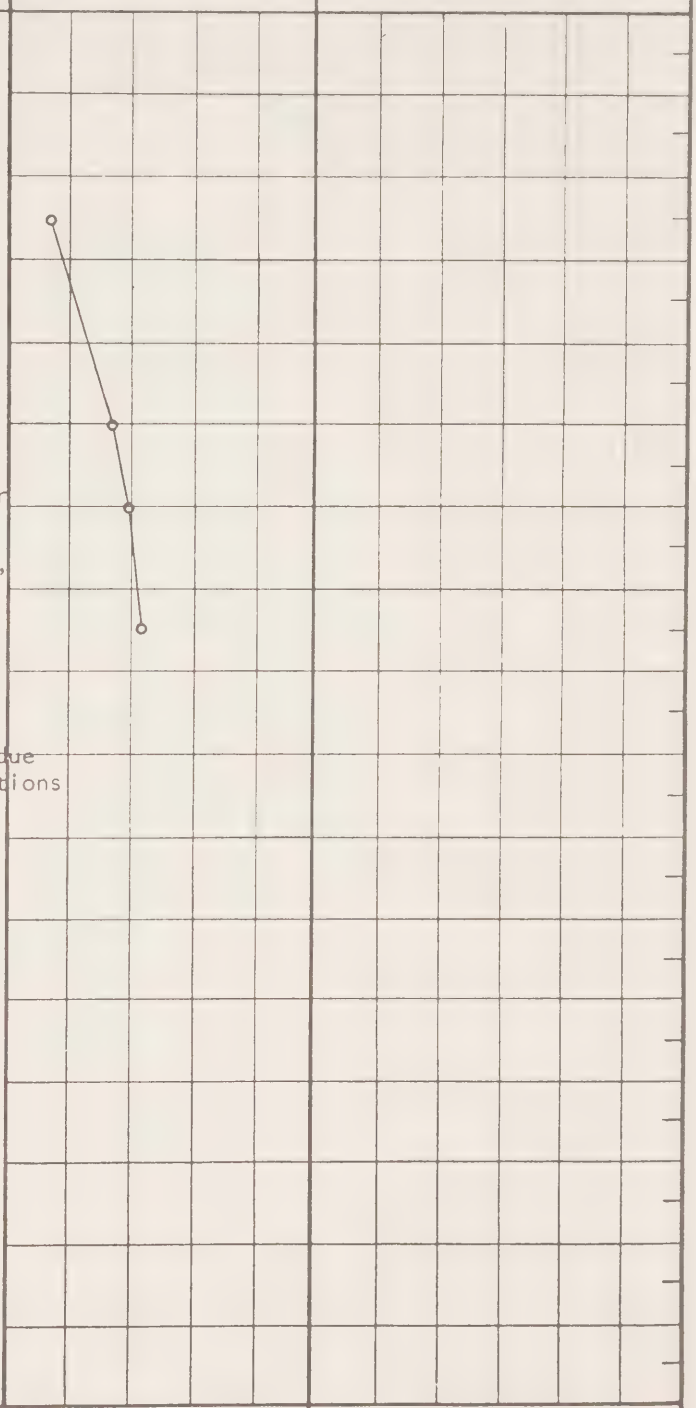
PROJECT Fort Simpson Sibdivision

TESTHOLE No. 102

SURFACE ELEVATION

JOB No. E - 498

Depth ft.	SOIL DESCRIPTION
	SAND brown, fine, uniform, medium dense, dry
2	
4	
6	
8	
10	
12	grey, wetter and coarser with depth
14	saturated and sloughing, Temp. 38.6°F to 39°F
16	END OF HOLE
	NOTE: Hole terminated at 15' due to sloughing soil conditions encountered at 13'.



Completion Depth 15 Date Oct 5/72

Depth to Water in Boring No free water slough at 13'

Page 1 of 1

Dwg. No. 2

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	103
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % o (10 20 30 40)	Compressive Strength tsf. (1 2 3 4 5)
2	SAND grey-brown becoming greyer with depth, fine becoming coarse with depth, sloughing from 3', moist		
4			
6	saturated, Temp 36.6°F		
8			
10			
12			
14	medium, uniform		
16	END OF HOLE		
	NOTE: Hole terminated at 15' due to sloughing soil conditions. Hole sloughed into 3' on completion.		



Completion Depth 15 Date Oct 5/72

Depth to Water in Boring No free water sloughed to 3'

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 3

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	104
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % o (10 20 30 40)	Compressive Strength tsf. (1 2 3 4 5)
0	SAND brown, clean, uniform, medium dense		
2			
4			
6	moist, sloughing		
8			
10			
12	some clay, uniform		
14			
16	END OF HOLE		
	NOTE: Hole terminated at 15' due to sloughing soil conditions. Slough at 7' on completion.		



Completion Depth 15' Date Oct 6/72

Depth to Water in Boring No free water Sloughed to 7'

Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 4

PROJECT Fort Simpson Subdivision

TESTHOLE No. 105

SURFACE ELEVATION

JOB No. E - 498

Depth ft.	SOIL DESCRIPTION
2	SAND brown, clean, uniform, moist, medium dense, hole sloughing at 2'
4	
6	
8	grey, coarse, uniform, saturated
10	
12	
14	
16	END OF HOLE

NOTE: Hole terminated at 15' due to sloughing soil conditions at 2'. Slough at 7½' on completion.

Water Content % o
10 20 30 40

Compressive Strength tsf.
1 2 3 4 5



10 20 30 40 50
Penetration Resistance N

Completion Depth 15 Date Oct 6/72

Depth to Water in Boring No free water slough at 7½'

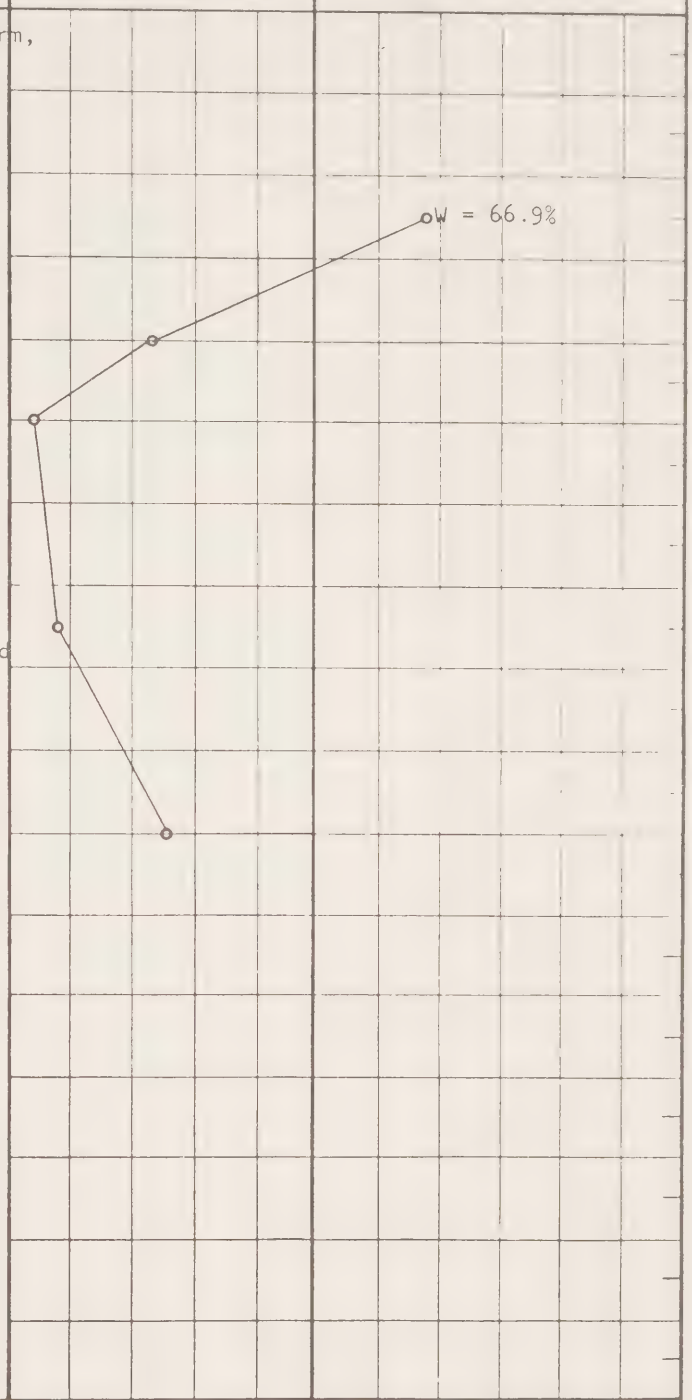
Page 1 of 1

Dwg. No. 5

PROJECT	Fort Simpson Subdivision	TESTHOLE No. 106
SURFACE ELEVATION		JOB No. E - 498

Depth ft.	SOIL DESCRIPTION
2	SAND — brown, some silt, uniform, frozen to 1', medium dense below 1'
4	sloughing from 2'
6	SILT — brown, sandy, wet
8	soft
10	SAND — brown, clean, uniform medium dense, moist
12	
14	
16	grey, uniform, saturated
18	
20	END OF HOLE

NOTE: Hole Sloughing from 2' depth.



Completion Depth 20 Date Oct 6/72

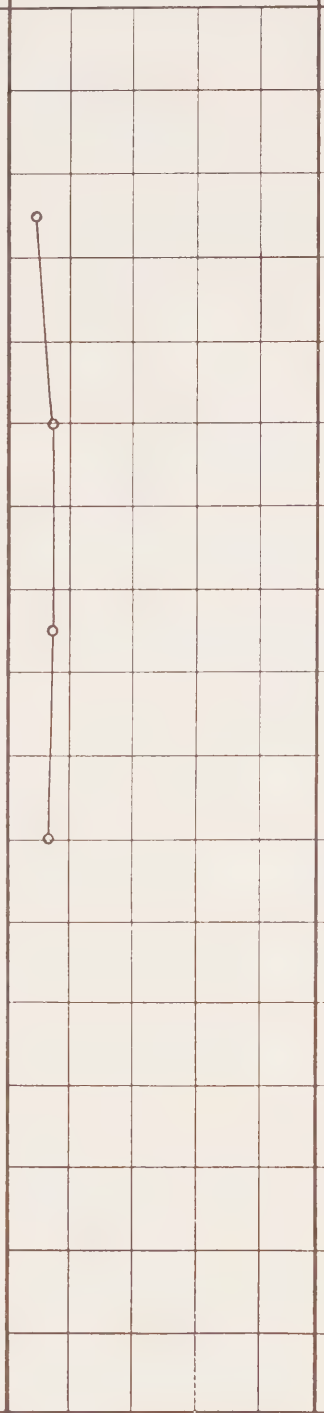
Depth to Water in Boring No free water sloughing from 2

Page 1 of 1

Dwg. No. 6

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	107
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	SAND brown, uniform, medium dense, sloughing from 1½', moist
2	
4	
6	
8	
10	
12	
14	
16	
18	coarser
20	
	END OF HOLE
	NOTE: Hole sloughing from 1½'. Sloughed into 16' on completion





Completion Depth 20 Date Oct 6/72

Depth to Water in Boring No free water slough at 16' Page 1 of 1

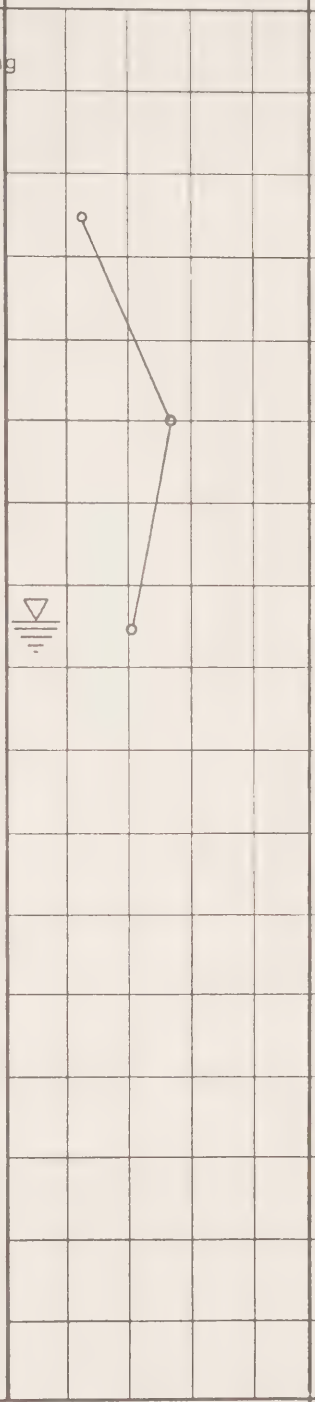
10 20 30 40 50

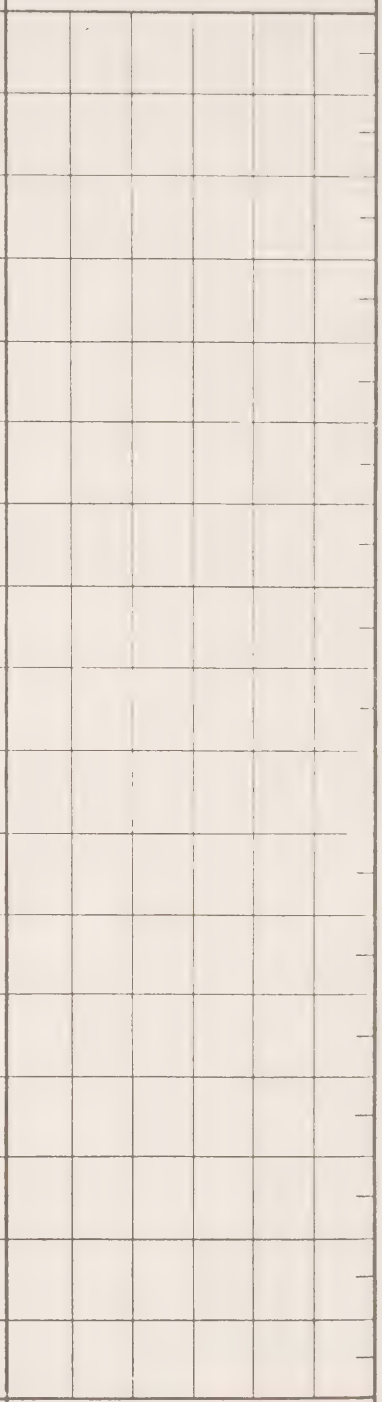
Penetration Resistance N

Dwg. No. 7.

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	108
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
	SAND brown, fine to medium grained, moist, sloughing from 2'
2	
4	
6	grey-brown, becoming greyer with depth and wetter
8	
10	
12	grey
14	free water
16	END OF HOLE
	NOTE: Hole terminated at 15' due to sloughing from 2'. Free water at 15' on completion





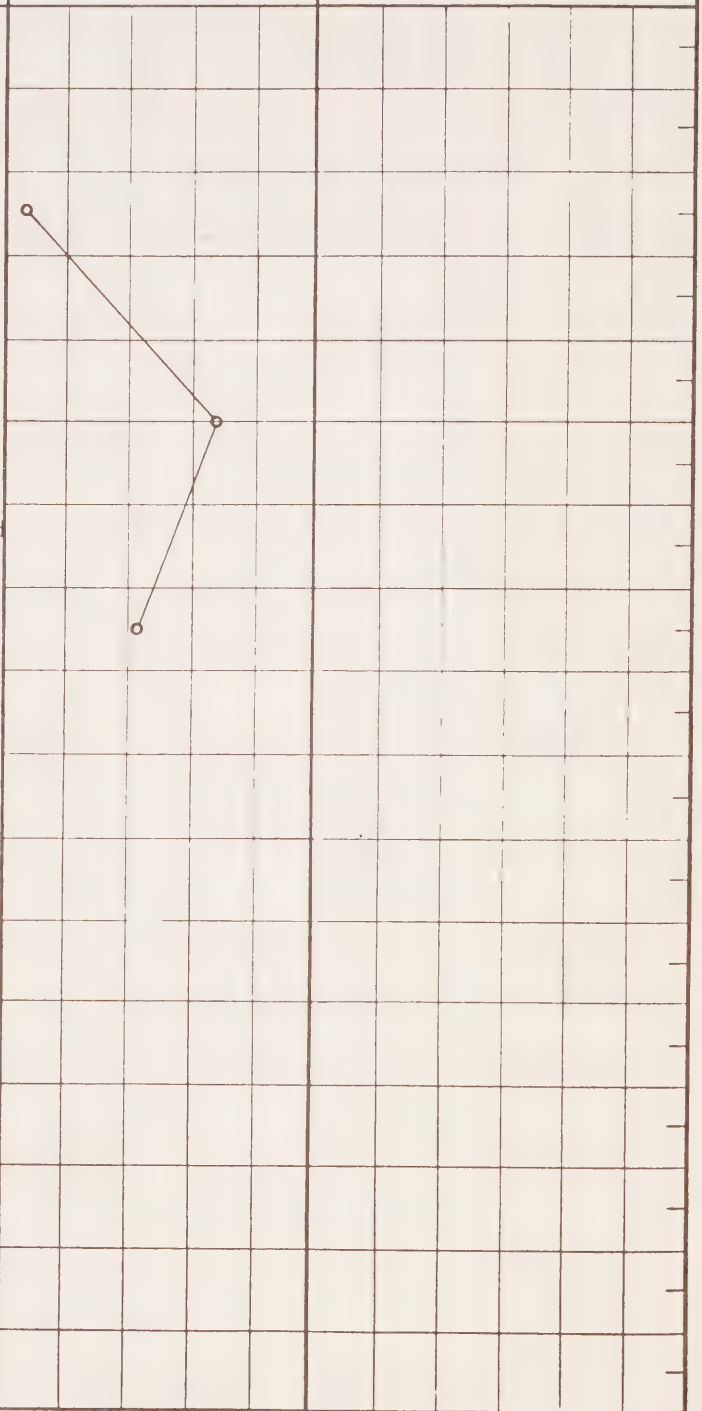
Completion Depth	15'	Date	Oct 6/72
Depth to Water in Boring	15' on completion	Page	1 of 1

10 20 30 40 50
Penetration Resistance N

Dwg. No. 8

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	109
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION
2	SAND mottled brown, coarse, uniform, moist, medium dense
8	SILT grey, sandy, wet, firm
12	SAND mottled brown, saturated
16	END OF HOLE
	NOTE: Hole sloughed to 8' on completion.



Completion Depth	15'	Date	Oct 6/72
Depth to Water in Boring	No free water slough at 8'	Page	1 of 1
Dwg. No.	9		

PROJECT Fort Simpson Subdivision

TESTHOLE No. 110

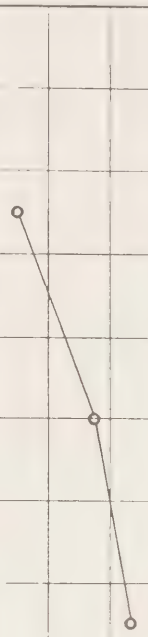
SURFACE ELEVATION

JOB No. E - 498

Depth ft.	SOIL DESCRIPTION
	SAND brown, mottled, fine, uniform, moist
2	sloughing from 1½'
	coarser with depth
4	medium grained, uniform
6	
8	
10	
12	grey, saturated
14	
16	END OF HOLE
	NOTE: Hole terminated at 15' due to sloughing from 1½'. Slough at 8' on completion.

Water Content % o
10 20 30 40

Compressive Strength tsf.
1 2 3 4 5



10 20 30 40 50
Penetration Resistance N

Completion Depth 15 Date Oct 6/72

Depth to Water in Boring No free water slough at 8'

Page 1 of 1

Dwg. No. 10

PROJECT	Fort Simpson Subdivision	TESTHOLE No.	111
SURFACE ELEVATION		JOB No.	E - 498

Depth ft.	SOIL DESCRIPTION	Water Content % (10 20 30 40)	Compressive Strength tsf. (1 2 3 4 5)
0	SAND light brown, becoming darker with depth, fine, medium dense, moist		
2			
4	sloughing from 2'		
	temp. 40°F		
6			
8	mottled brown, coarse		
10			
12			
14			
16	medium grained, uniform		
18			
20	END OF HOLE		
	NOTE: Hole sloughing from 2'. Slough at 13.5' on completion.		

Completion Depth 20' Date Oct 7/72

Depth to Water in Boring No free water slough at 13.5' Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 11

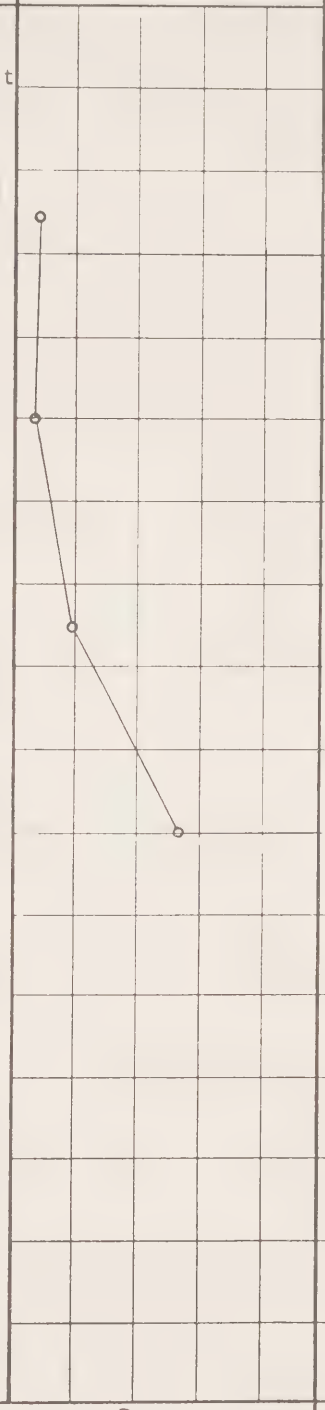
PROJECT Fort Simpson Subdivision

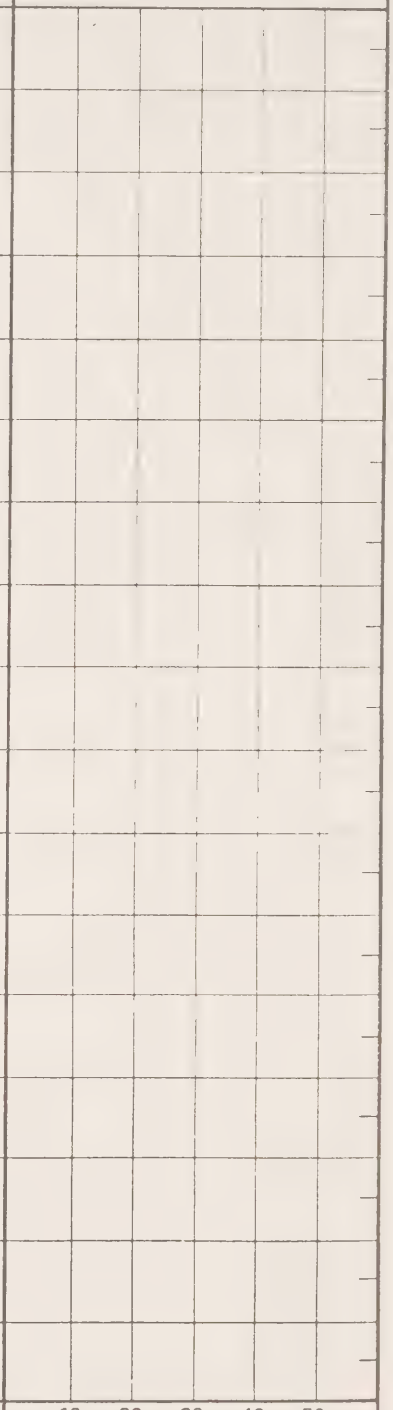
TESTHOLE No. 112

SURFACE ELEVATION

JOB No. E - 498

Depth ft.	SOIL DESCRIPTION
	SAND light brown, fine
2	sloughing from 2', moist
4	mottled brown, fine to medium grained
6	
8	
10	
12	
14	
16	
18	grey, saturated, coarse sand, small pieces of petrified wood
20	
	END OF HOLE
	NOTE: Hole sloughing from 2'. Slough at 13' on completion.





Completion Depth 20' Date Oct 7/72

Depth to Water in Boring No free water slough at 13'

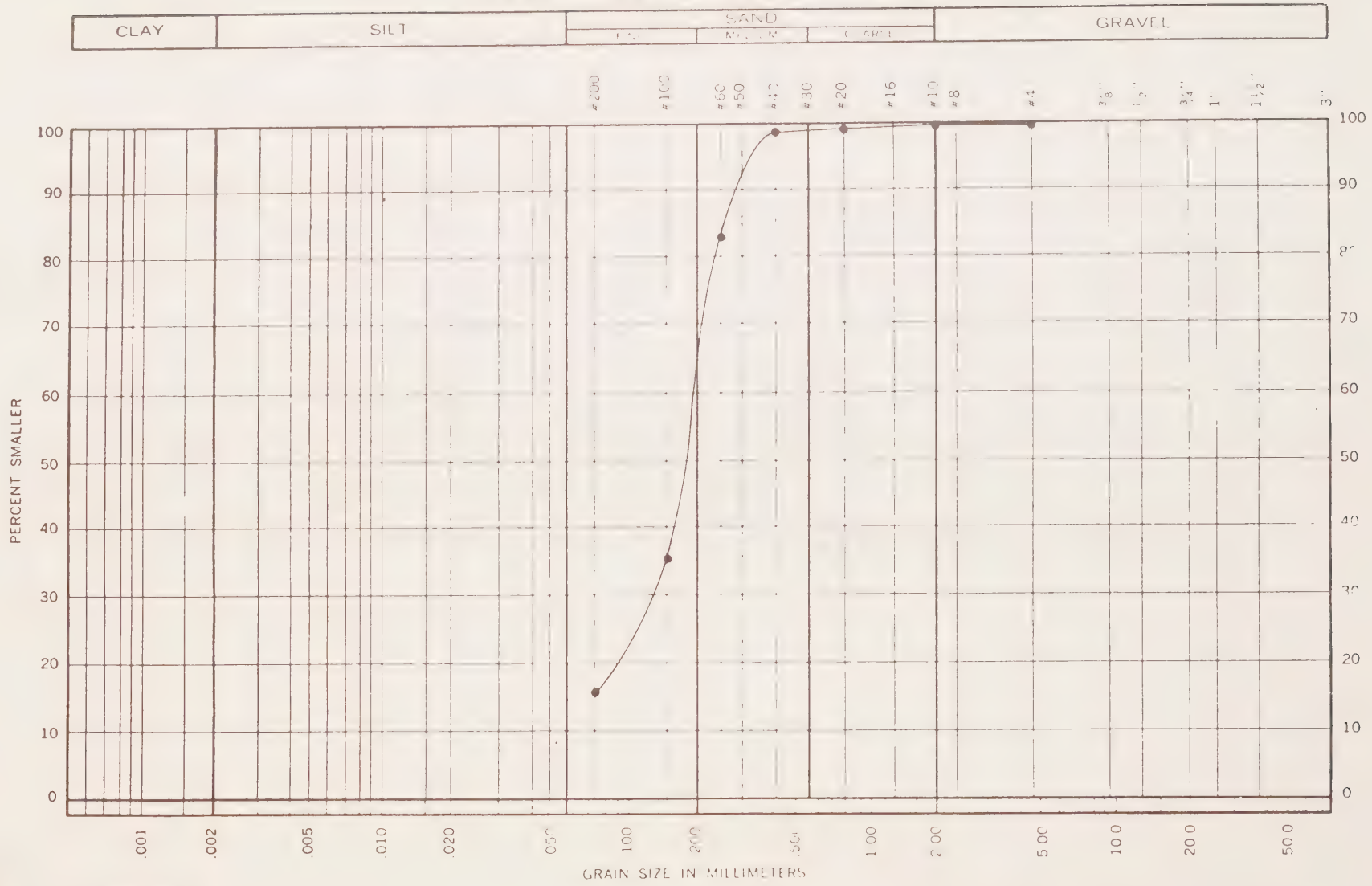
Page 1 of 1

10 20 30 40 50

Penetration Resistance N

Dwg. No. 12

GRAIN SIZE DISTRIBUTION



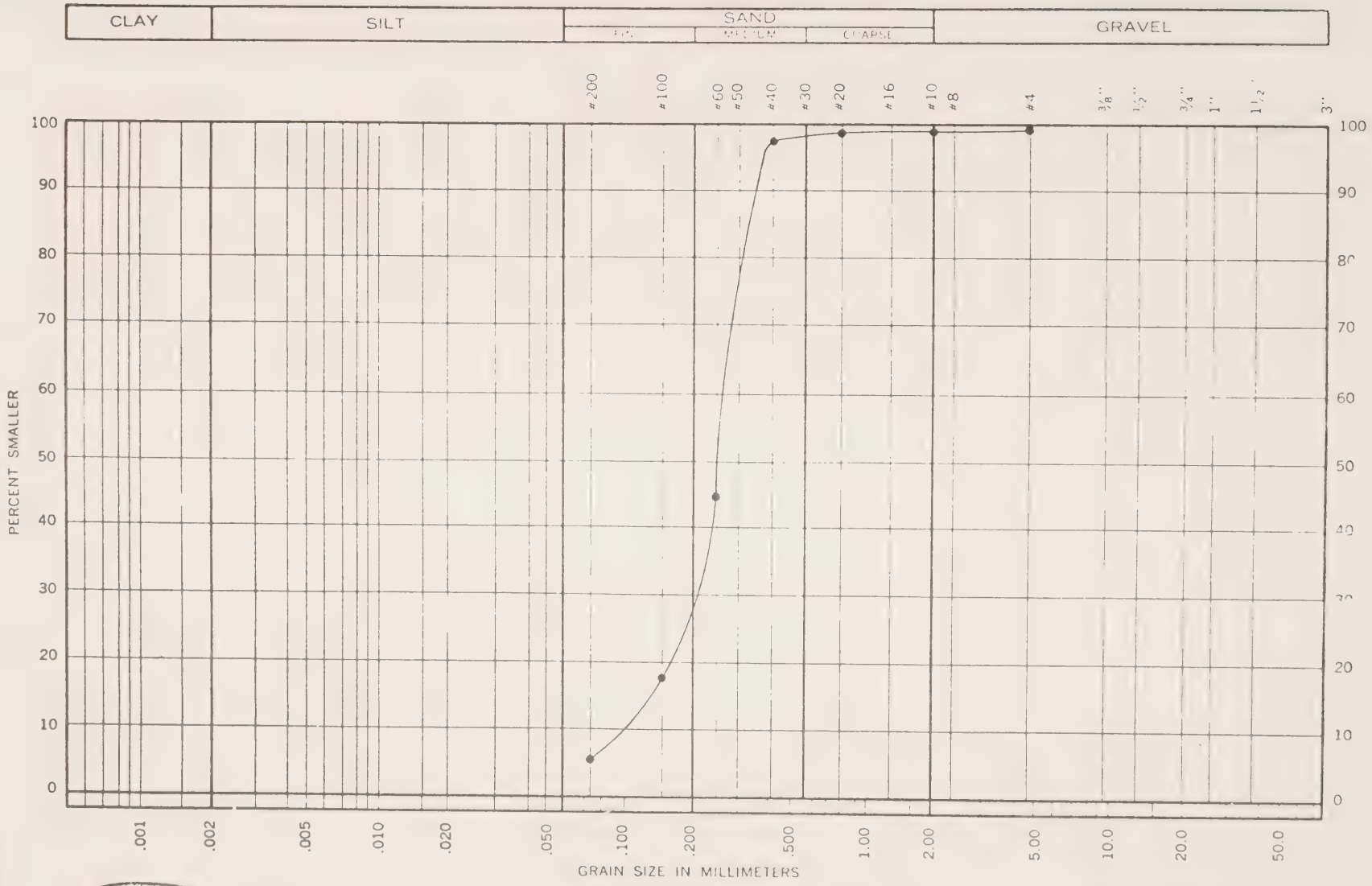
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION FINE TO MEDIUM SAND

PROJECT FORT SIMPSON SUBDIVISION
JOB No E498 DATE 13/10/72
SAMPLE No. T.H 101
DEPTH 10'

FIGURE 13

GRAIN SIZE DISTRIBUTION



BROOKER & ASSOCIATES

SAMPLE DESCRIPTION MEDIUM SAND

PROJECT FORT SIMPSON SUBDIVISION
JOB No. E498 DATE 13/10/72
SAMPLE No. T.H.103
DEPTH 15'

FIGURE 14

GRAIN SIZE DISTRIBUTION

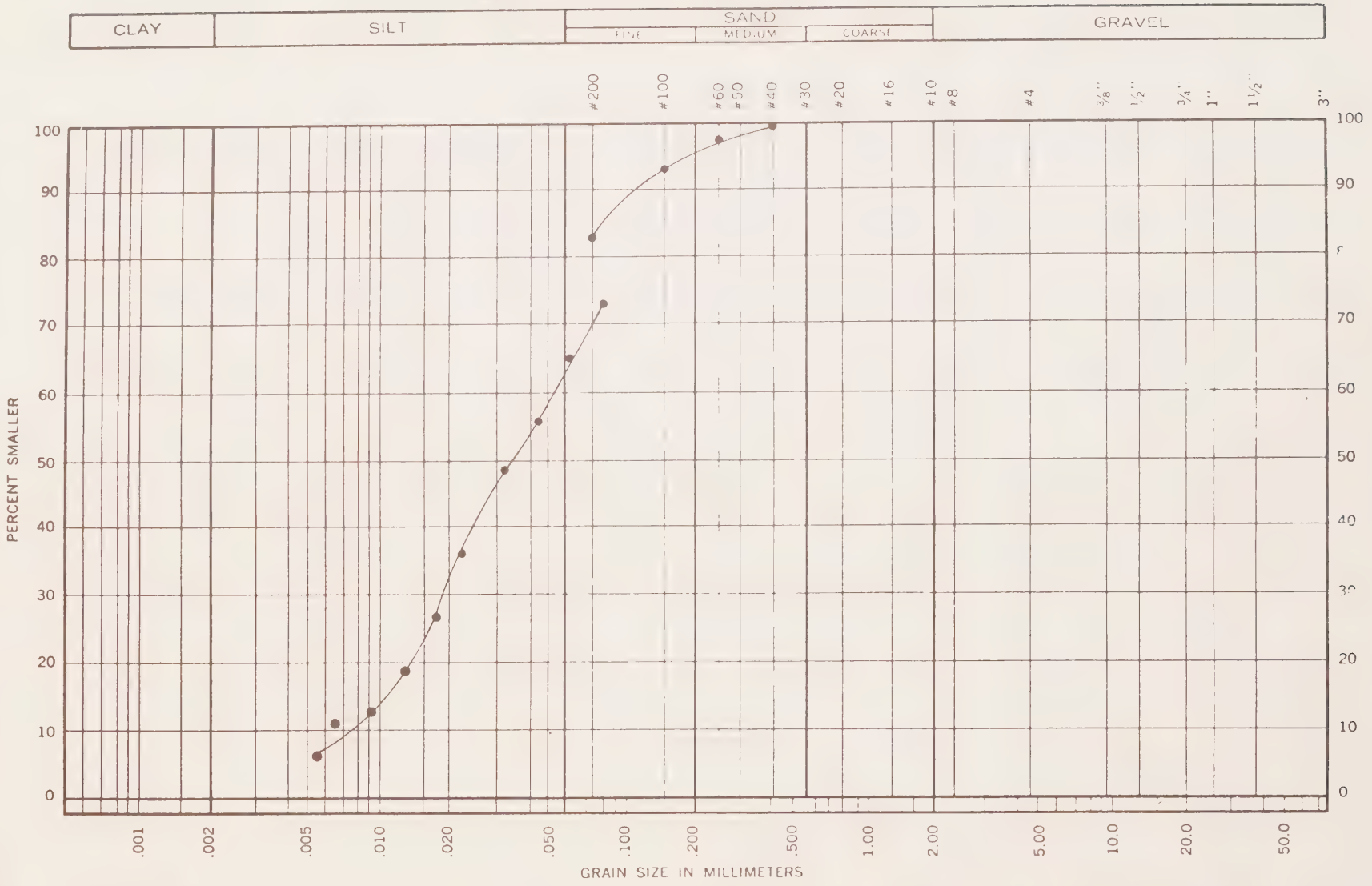


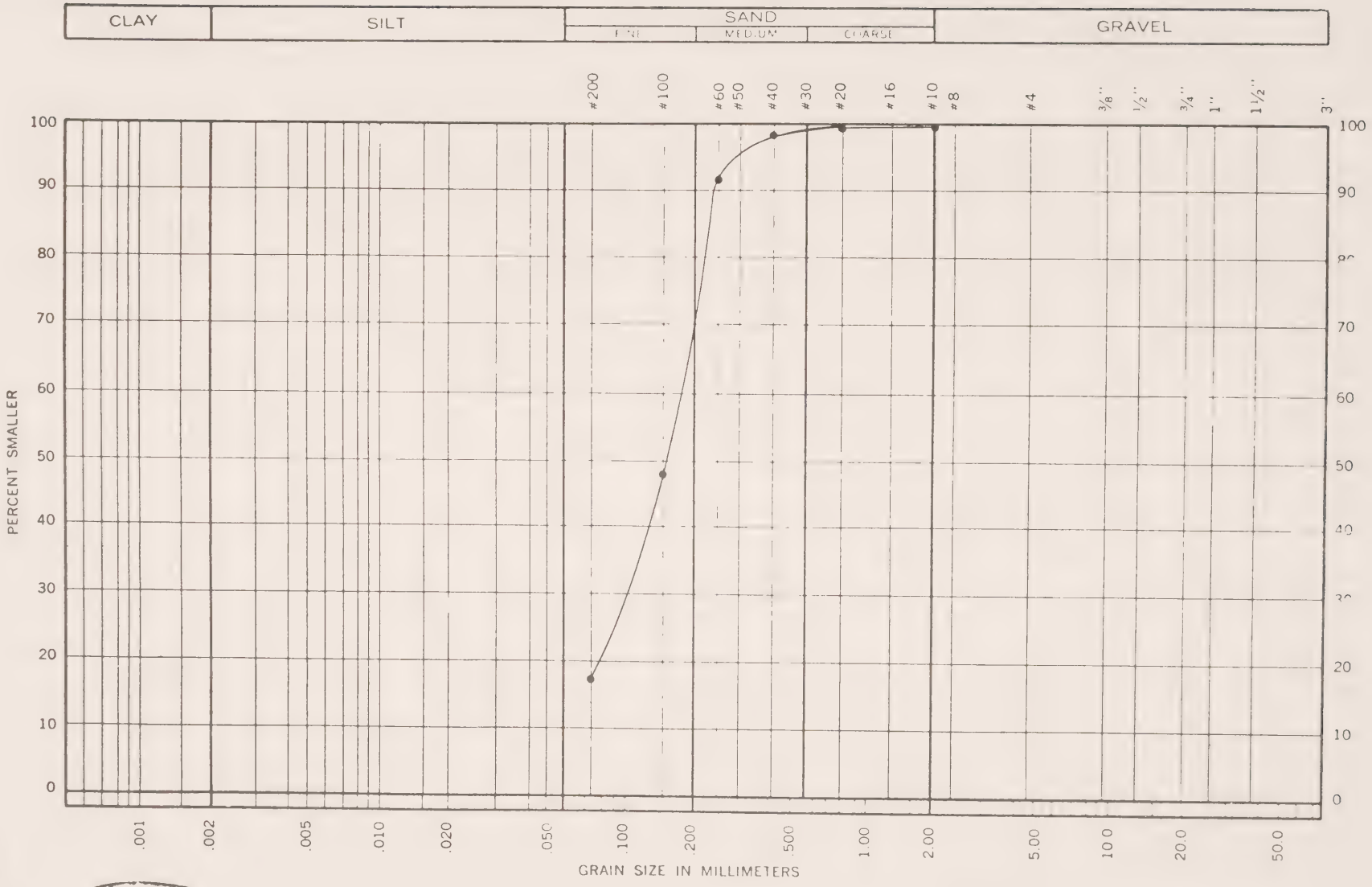
FIGURE 15

BROOKER & ASSOCIATES

SAMPLE DESCRIPTION SANDY SILT

PROJECT FORT SIMPSON SUBDIVISION
JOB No. E498 DATE 13/10/72
SAMPLE No. T. H. 106
DEPTH 8'

GRAIN SIZE DISTRIBUTION

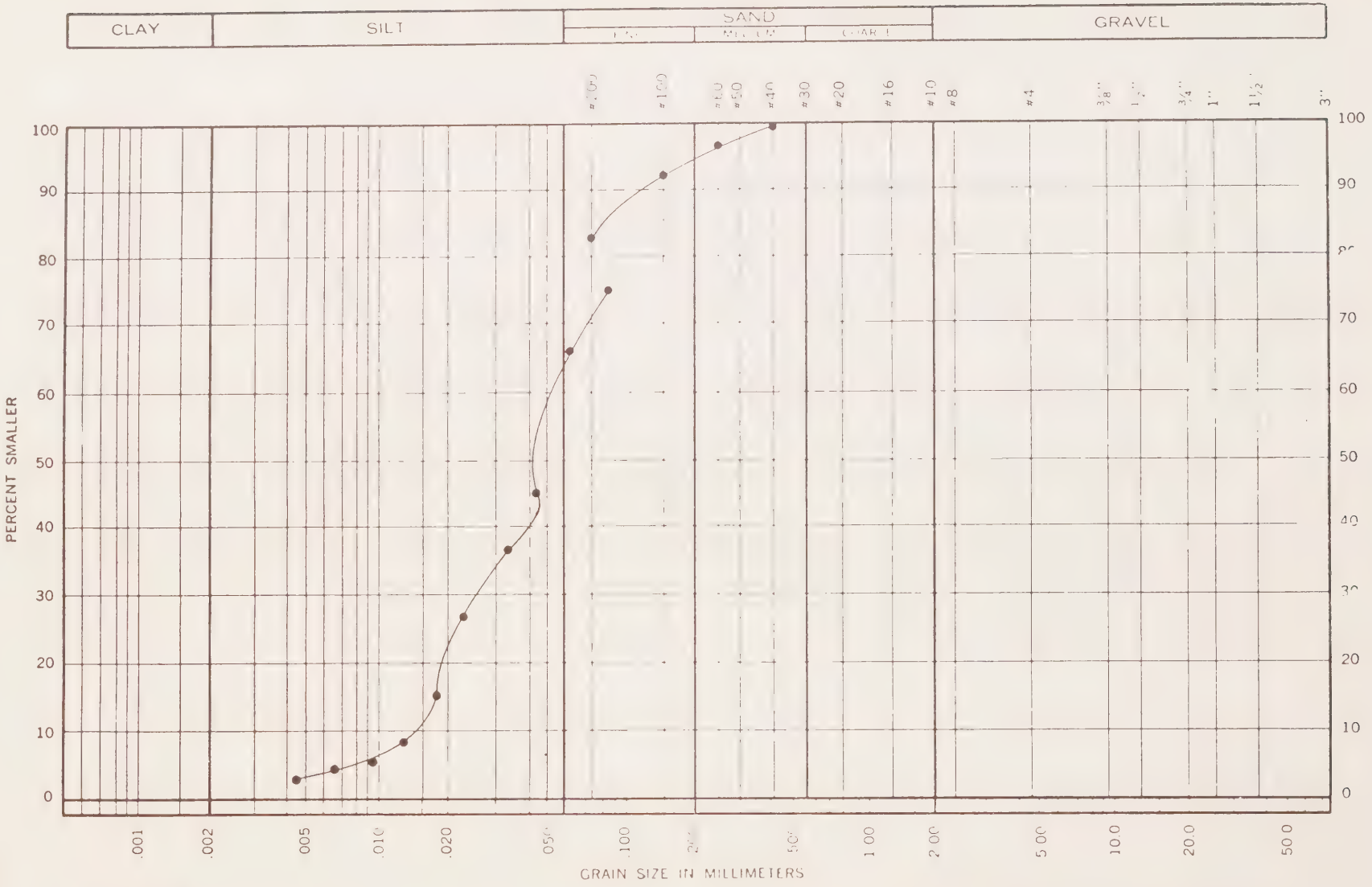


BROOKER & ASSOCIATES

SAMPLE DESCRIPTION FINE SAND

PROJECT FORT SIMPSON SUBDIVISION
JOB No. E 498 DATE 13/10/72
SAMPLE No. T.H. 107
DEPTH 10'

GRAIN SIZE DISTRIBUTION



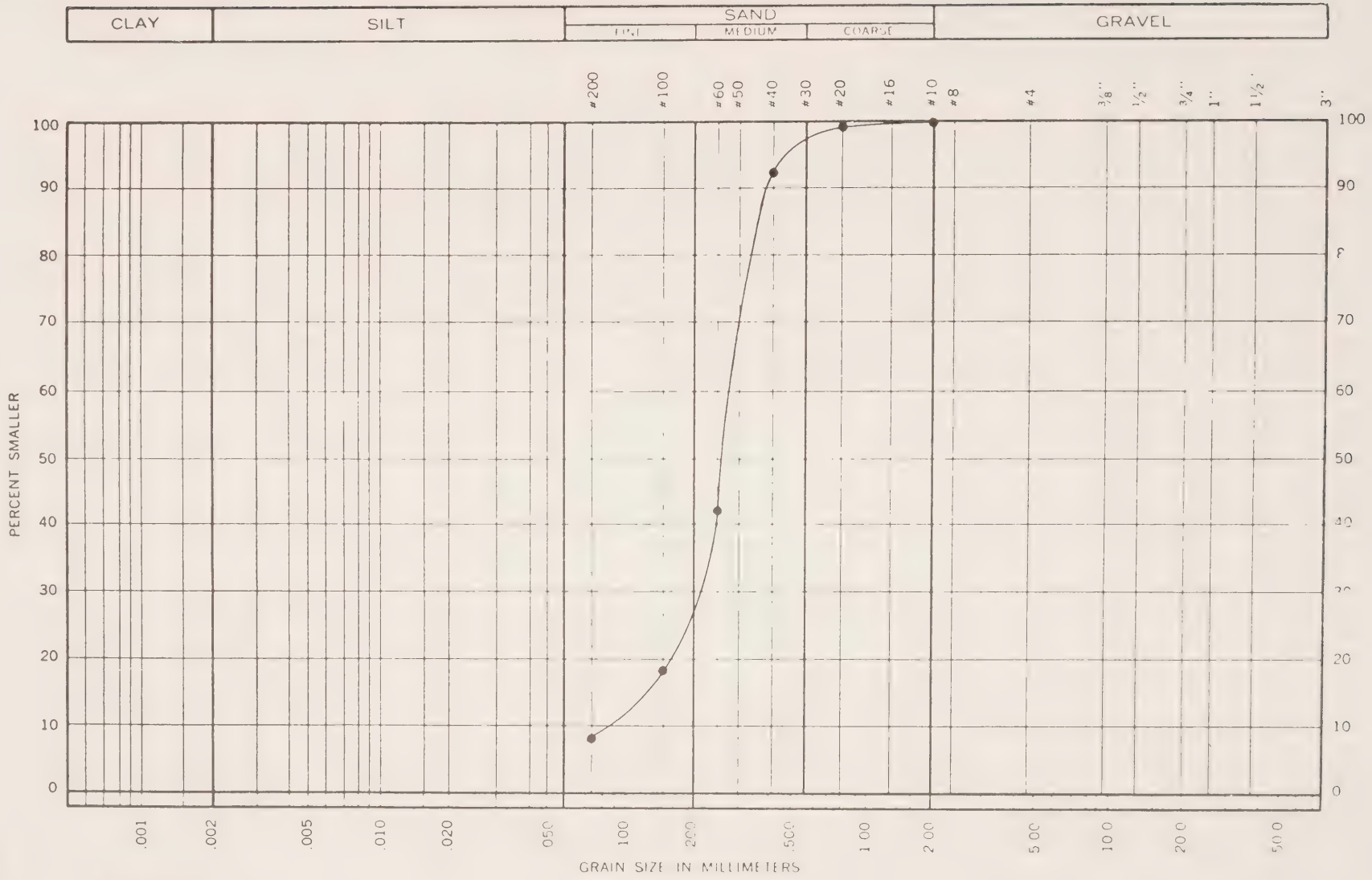
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION SANDY SILT

PROJECT FORT SIMPSON SUBDIVISION
JOB No. E498 DATE 13/10/72
SAMPLE No. T.H. 109
DEPTH 10'

FIGURE 17

GRAIN SIZE DISTRIBUTION



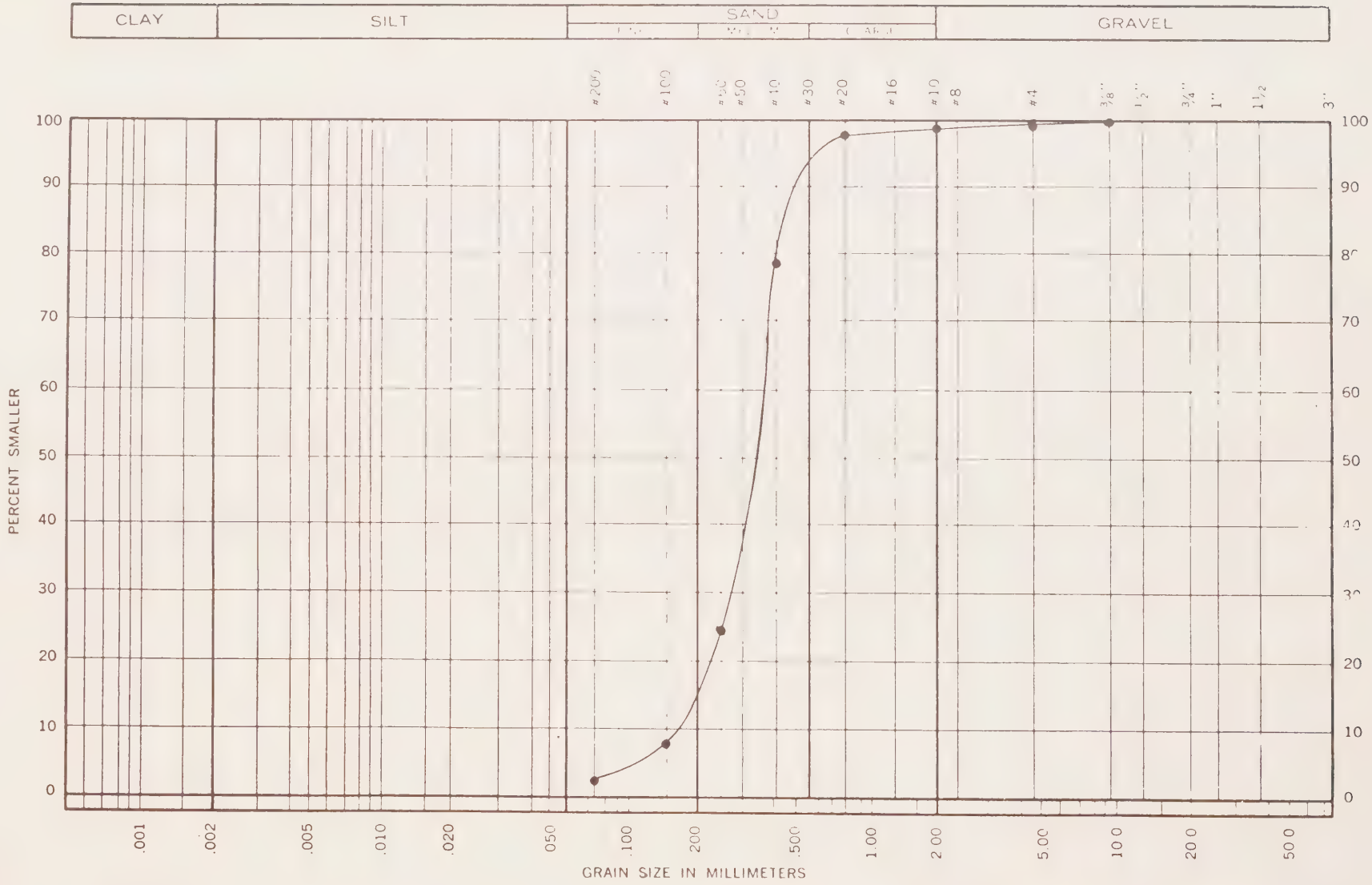
BROOKER & ASSOCIATES

SAMPLE DESCRIPTION MEDIUM SAND

PROJECT FORT SIMPSON SUBDIVISION
JOB No. E 498 DATE 13/10/72
SAMPLE No. T.H. 110
DEPTH 5'

FIGURE 18

GRAIN SIZE DISTRIBUTION

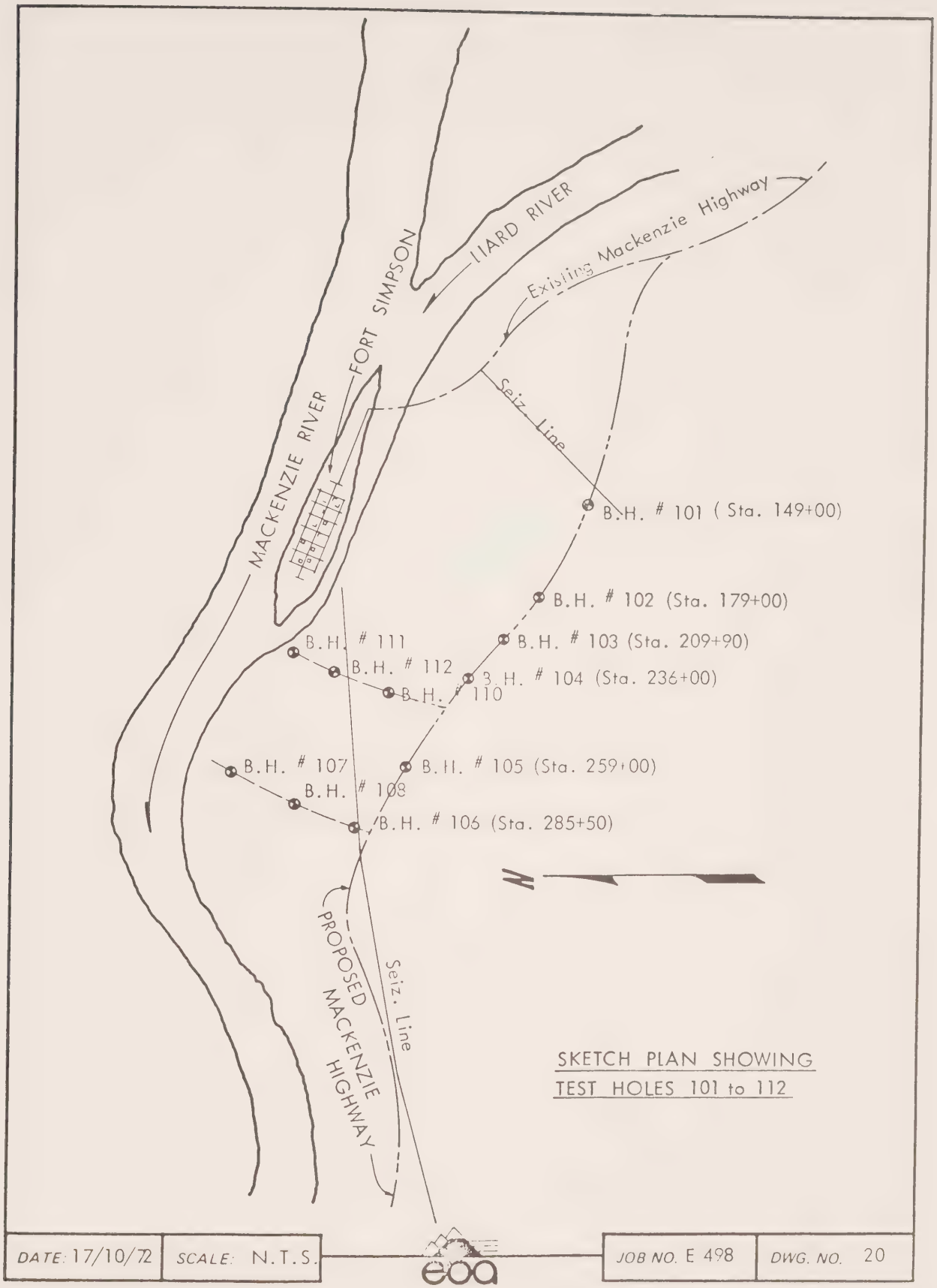


BROOKER & ASSOCIATES

SAMPLE DESCRIPTION MEDIUM SAND

PROJECT FORT SIMPSON SUBDIVISION
JOB No. E 498 DATE 13/10/72
SAMPLE No. T.H. III
DEPTH 15'

FIGURE 19


MACKENZIE RIVER
FORT SIMPSON
LIARD RIVER
Existing Mackenzie Highway
Seiz. Line
B.H. # 101 (Sta. 149+00)
B.H. # 102 (Sta. 179+00)
B.H. # 111
B.H. # 103 (Sta. 209+90)
B.H. # 112
B.H. # 104 (Sta. 236+00)
B.H. # 110
B.H. # 107
B.H. # 105 (Sta. 259+00)
B.H. # 108
B.H. # 106 (Sta. 285+50)
N
PROPOSED MACKENZIE HIGHWAY
Seiz. Line
SKETCH PLAN SHOWING
TEST HOLES 101 to 112
DATE: 17/10/72
SCALE: N.T.S.
eda
JOB NO. E 498
DWG. NO. 20

A P P E N D I X "B"

MOBILE HOME PARK - INFORMATION FOR PROSPECTIVE DEVELOPERS AND GENERAL DESIGN STANDARDS

General Description

The mobile home park site is located in Fort Simpson, N.W.T. on a relatively flat area of the mainland, immediately across the snye from Fort Simpson Island.

The site consists of approximately forty (40) acres, and proposals are invited for development of a minimum of 200 mobile home sites in this area, designated as Phase 1 on the accompanying plan.

The density for the mobile home park is to be less than six (6) mobile home lots per gross acre.

Preliminary soils testing has been carried out on the mainland, and soils information is available from the Village or its Engineers. In addition, a contour plan prepared from aerial photography is appended to this brief.

It is a condition of this development that all services within the site will be provided by the Developer, to standards acceptable to the Village.

The Village will provide a supply of water to the boundary of the site, and will provide a sewage outfall line from the boundary. Provision of water and acceptance of sewage by the Village will be under terms of a development agreement to be negotiated between the Developer and the Village.

General Requirements

To ensure a high-quality standard in this type of residential community - the mobile home park - the following provisions are essential and must be part of the terms of reference for the prospective developer.

1. High standard gravel streets, (32 ft. top).
2. Sidewalks (Concrete - one side only.)
3. Ornamental Street Lighting.
4. Underground wiring - underground services.
5. Complete landscaping.
6. A gravel or concrete foundation pad.
7. Water, electricity, sewer and telephone connections.
8. Playgrounds.
9. Storage compounds.
10. Off-street parking.
11. Utility buildings.

Special Requirements

A. Definitions

1) "Mobile home" means a transportable single family dwelling unit suitable for long term occupancy, designed to be transported on its own wheels or by other means and arriving at the site ready for occupany apart from incidental operations such as location on foundation supports and connection to utilities.

2) "Mobile home lot" means a parcel of land for the placement of a single mobile home and the exclusive use of its occupants.

3) "Mobile Home Park" means a parcel of land under single ownership which has been planned and improved for the placement of mobile homes for non-transient use.

4) "Mobile Home Stand" means that part of an individual lot which has been reserved for the placement of the mobile home, appurtenant structures or additions.

B. Special Provisions

1) A person applying to develop a site for a Mobile Home Park shall conform to the following special provisions:

2) The maximum permissible density for a mobile home park shall be six (6) mobile home spaces per gross acre.

3) The minimum size for a mobile home lot shall be 4,000 square feet.

4) Mobile Homes shall be separated from each other by at least 20 feet side-to-side and 20 feet end to end, provided further that any porch or addition to the mobile home is regarded as part of the mobile home for the purposes of spacing.

5) There shall be at least one car parking space provided on each mobile home lot and provision shall be made for visitor parking at the ratio of one space to every two mobile home lots. This visitor parking provision shall be dispersed throughout the park and shall not be used for the storage of boats, trailers, etc.

6) All accessory structures such as patios, porches, additions and skirtings shall be so designed and erected as to harmonize with the mobile home.

7) There shall be no visible outside storage of any furniture, domestic equipment or seasonally used equipment on the individual stands. Provision should be made for adequate covered screened storage either individually or communally.

8) Recreation space shall be provided at the ratio of at least 100 square feet per mobile home lot. This recreation space shall be placed in locations convenient to all the park residents, free from traffic hazards and shall not be included in areas designated as buffer strips. Where the recreation requirements exceed 5,000 square feet, two or more recreation areas should be provided. Playgrounds shall be furnished adequately to meet their function.

9) Screen fences or walls shall be erected where necessary around laundry yards, refuse collection points, and playgrounds. All mobile homes shall be provided with durable skirting to screen the view of the undercarriage.

10) All utility lines shall be placed underground.

11) All areas of a mobile home park not occupied by mobile homes and their additions, internal roads, footpaths, driveways, permanent buildings and any other developed facilities shall be fully landscaped.

12) All roads in the park shall be gravelled.

13) All landscaping and screening shall be to the complete satisfaction of the City.

14) No part of the park shall be used for non-residential purposes except as approved in the development plan.

15) Mobile Home Park facilities shall be arranged to create a home-like atmosphere. This objective is achieved by variations in street pattern, block shapes and location of mobile home stands.

16) Each mobile home lot shall be clearly marked off by means of stakes, fences or hedges.

17) Except as stated herein, every mobile home park shall comply with the provisions of municipal, territorial, and federal regulations.

Terms of Reference for Prospective Developer

1. Sales Price for Land

plus legal and registration fees.

2. Submitting Development Plan for approval

based on street and block arrangements as shown in provisional survey plan or an alternate plan devised by the developer to similar standards to arrive at a more pleasant or suitable layout for the single mobile home lots.

The proposed development plan must at least include the essential provisions as listed under "General Requirements" and should describe any additional features to be incorporated.

More details, which are part of the terms of reference, are paragraphed under the section "Special Requirements."

Provisional Engineering plans for utilities, roadworks and other related engineering plans must be submitted with the Development Plan. A detailed Cost Estimate must be included in the submission.

3. Performance Bond or Guarantee Bond

to be 20% of Cost Estimate submitted with the Development Plan and released upon acceptance of the work. A further bond to guarantee pavement, curbs and improved drainage at a later date may be required as stipulated elsewhere.

4. Starting date of actual construction

May 15th, 1973.

5. Completion date and ready for occupancy

September 1st, 1973.

different and later dates to be negotiated for different items.

Sidewalks, curbs, paving and improved drainage:

September 30th, 1974.

Landscaping:

September 30th, 1974.

6. Maintenance Period

One year after formal completion.

Cost of Maintenance for whole Park will be responsibility of the developer, including Snow Clearing on streets, garbage pick-up and other municipal services which will be performed by the Village and charged back.

7. Utilities and Right-of-Ways

a) Utilities - Water and Sewer Mains and Roads within the Road rights-of-way will become the property of the Village at the end of the formal Maintenance Period without cost to the Village but only when official inspection shows no defect or after defects have been corrected by the Developer. House Connections remain private property and private responsibility.

b) Rights-of-Way - will be registered in the name of the Queen at the time of the registration of the park without compensation to the developer.

Road construction, sidewalks, and other related items on Rights-of-Way are subject to the same provisions as "Utilities."

8. Operation and Management of Mobile Home Park

A proposal stating the intended operation, management and Rental structure shall be submitted with the Development Plan and with all other submissions required. The Mobile Home Park operator is charged with keeping accurate and detailed records of all mobile homes occupying his park and records must be made available to the City on a monthly basis.

9. Oversize of Site Services

Where development of the Phase 2 site would normally require oversize, extra depth or slopes of sewer, water or any other utility line, roadway, etc. then the developer shall install services to the necessary improved standard. Cost of oversizing will be borne by the Developer.

10. General Design Standards

The prospective developer is referred to the "General Design Standards" for details of required construction.

VILLAGE OF FORT SIMPSON

GENERAL DESIGN STANDARDS

Development by Private Developers

1. General

The proposal submitted by the Developer should be a preliminary proposal.

It should be submitted at an early stage so that changes desired by the Town Council can be easily made.

The proposal should include all pertinent information as to standards of construction, density of population, requirements for capacity of sewers, water mains, roads and any other specific requirements.

The Developer shall engage a qualified professional engineer for designing municipal services to be installed as part of the proposed development. Such engineer shall design these services in accordance with accepted engineering practices and to the minimum standards as set out herein. Such engineer shall further supervise the construction of the municipal services and inform the Village of any deficiencies that might have come to light during the construction.

The Developer's Engineer shall submit complete plans of all construction proposed with the Village and specifications for same. Complete as-built plans for all construction are required to be submitted to the Village upon completion.

The Developer will be responsible for all work carried out and the Village will only officially take over any services installed upon completion of the work and expiration of a one year maintenance period and after a final inspection and acceptance by the Village following the maintenance period.

No construction shall be undertaken until a development agreement between the Village and the Developer has been signed. Prior to construction, the Village shall receive complete plans and specifications of the work.

The Developer and Contractor shall carry sufficient insurance in favour of the Village to cover any and all liability claims that may arise through the proposed development. The amount of this insurance shall be determined by the Village.

The Village will commence undertaking normal maintenance operations of the work upon acceptance of the work by the Village, excepting abnormal maintenance work caused by the Developer or by the Builder's operations. Any work required under the maintenance bond will be referred to the Developer for proper action by the Contractor.

2. Sewers

Sewers shall be asbestos-cement or asphalt-coated corrugated metal. Minimum depth shall be six feet from top of pipe to finished grade. Manholes shall not be spaced more than 300 feet apart and at all bends or junctions. Manholes shall be insulated. Minimum size of sewer shall be eight inches in diameter.

3. Watermains

Watermains shall be ductile iron or steel, cement-lined and coated as required to prevent corrosion. Minimum watermain size shall be six inches. Hydrants shall be installed at intervals not exceeding five hundred feet along all streets. In addition, hydrants shall be installed in locations as required to provide convenient service to all lots.

The water distribution system design shall be approved by the Fire Marshall of the Northwest Territories before construction. The system of valving to be used shall meet the approval of the Village. Generally, valves should be located at intersections, and should be arranged to provide for isolation of any 500 feet length of main. Two separate connections to the supply line shall be made to guard against system freeze-up in case of a break and to provide continuing service and fire protection.

Hydrants and valves shall match existing fittings in the Village.

4. Service Connections

Service Connections shall be installed and constructed in a method to be approved by the Village and to guard against freezing. All terminals at the mobile home location shall be cased and capped in metal pipe or concrete pads with removal metal caps. Any portion of the service connection line in frozen soil zones shall be provided with a positive means of heating and insulation, designed to resist deterioration by moisture. Water connection lines shall be 3/4 inch copper, Type K soft. Sewer connection lines shall be four inch diameter, of approved material. Mainline ties shall be used for sewer service connections. Curb stops shall be located at the mains and installed to guard against freezing.

5. Roads and Drainage

Roads shall be constructed of crushed gravel, to a width of thirty feet minimum. A minimum of six inches of compacted gravel shall be installed over compacted sub-grade. Longitudinal grades shall be such that curbing and asphaltic pavement can be installed at a later date. Drainage shall be provided throughout the development, and all ditch crossings shall be fitted with suitable culverts.

6. Sidewalks

Concrete sidewalks shall be installed to provide paved walkway access to each mobile home stand and to each playground or other facility. Walks shall be four feet wide, four inches (minimum) thickness and reinforced at all driveway crossings.

7. Pavement, Curbs and Improved Drainage

Within a period of three years, concrete curbing, storm sewers and pavement shall be installed to standards acceptable to the Village. The details of design of these facilities shall be submitted to the Village and incorporated into the development agreement. For purposes of guaranteeing this work, a bond in the amount of the cost of the work as estimated by the Village shall be provided. Alternatively, a reserve fund for the purpose of providing for this work shall be established and monthly deposits to this fund shall be made from rental income at a rate per lot which will assure the required funds at the end of thirty-six months from the date of opening of this park.

8. Boulevards

All boulevard areas (between sidewalk and curb and gutters) and buffer strips, shall be filled to final grade with six inches of topsoil, at time of installation of curbs.

The cross slope across boulevards shall be one-quarter inch to three-eighths inch per foot minimum.

9. Traffic Control Devices and Street Name Signs

Standard traffic signs and traffic control devices shall be installed by the Developer and shall be in accordance with the Manual of Uniform Traffic Control Devices of the Canadian Good Road Association.

Reflectorized street name signs, of the type and colour satisfactory to the Village, mounted on two inch diameter steel posts shall be installed by the Developer in the area to be developed.

10. Power and Telephone Services

The power, and telephone services to be installed shall be arranged between the Developer and the respective utility companies and shall be underground. Any cost for these services charged by the respective utility companies, shall be paid by the Developer.

The Developer shall provide rights-of-way in each subdivision or register easements in the name of the Village for the purpose of utility services of sufficient size and location to the satisfaction of the utility companies.

11. Lot Drainage

The Developer shall submit to the Village, an overall plan of the area to be developed on which shall be indicated the individual lots with the proposed grading, together with existing lot elevations at the time of completion of installation of services and pre-grading of the overall area. Also indicated on this plan shall be the design sidewalk or top of curb elevations and the invert elevation of the sanitary sewer connection at the property line, and any swabs, ditches or culverts required to provide lot drainage.

In general, the lot layouts shall be such that the minimum slope in the front yard from the grade at the home to the sidewalk shall be not less than two per cent. The minimum slope in backyards shall be two per cent, while in cases where the backyard slope is towards the home, provisions are required to keep runoff at least ten feet away from the home.

Where the above slopes are not available, swabs or other suitable drainage improvements shall be constructed to ensure dry lots. Clearing and grading for drainage purposes will only be permitted in extreme cases.

12. Street Lighting

Street lighting shall be arranged for by the Developer to a standard of lighting comparable to existing standards within the Village for the several types of streets.

Street lighting cables shall be installed underground and an acceptable type of steel post with fixtures shall be provided.

Any capital cost that the utility company may charge for installation of street lighting to the above standard, shall be paid for by the Developer.

The Village will pay rental charges to the utility company providing street lighting, for the operation of street lights thus installed. The Village shall approve the street lighting layout prior to installation.

Street lights shall be placed at locations not interfering with proposed driveways.

The face of the posts shall be at least two feet away from the face of the curb.

13. Clearing

No clearing shall be carried out prior to submission and approval by the Village of a clearing plan. In general, clearing will be permitted only as necessary to provide for roadways, utilities, mobile home stands and access. In other areas, clearing of underbrush only will be permitted.

A P P E N D I X "C"

WATER TESTING ANALYSIS

WESTERN INDUSTRIAL LABORATORIES LIMITED

LABORATORY REPORT

TELEPHONE
439-7969

8109 - 102 STREET
EDMONTON ~~RX~~ ALBERTA
T6E 4A4

WATER ANALYSIS REPORT

Company: W. J. Francl & Associates Date: 11 Aug. 72

Sample: Turner Expedition well Report No.: 221-30

Fort Simpson Lab. No.: 72-1252

Determination		ppm	Epm
pH	7.6		
Total dissolved solids		314	
Ignition loss		60	
Sodium & Potassium (Calc. as Na)		13	
Calcium Ca		73	
Magnesium Mg		18	
Carbonate CO_3		--	
Bicarbonate HCO_3		320	
Alkalinity Total as $CaCO_3$		258	
Sulphate SO_4		7	
Chloride Cl		1	
Total Hardness as $CaCO_3$		256	
Iron Fe		0.10	
Fluoride F			
Turbidity as SiO_2		0.07	

Remarks:

WESTERN INDUSTRIAL LABORATORIES LIMITED

Frank Harrison RA

Frank Harrison

WESTERN INDUSTRIAL LABORATORIES LIMITED

LABORATORY REPORT

TELEPHONE
439-7969

8109 - 102 STREET
EDMONTON, ALBERTA T6E 4A4

WATER ANALYSIS REPORT

Company: W. J. Francl & Associates Date: 22 Sept. 72

Sample: MacKenzie River water Report No.: 221-31

9:30 a.m. 25 Aug. 72 Lab. No.: 72-1521

Determination		ppm	Epm
pH	7.8		
Total dissolved solids		188	
Ignition loss		106	
Sodium & Potassium (Calc. as Na)		3	0.12
Calcium Ca		25	1.25
Magnesium Mg		9	0.74
Carbonate CO_3		Nil	---
Bicarbonate HCO_3		88	1.44
Alkalinity Total as $CaCO_3$		72	---
Sulphate SO_4		20	0.42
Chloride Cl		9	0.25
Total Hardness as $CaCO_3$		99	---
Iron Fe		0.12	---
Fluoride F		---	---

Remarks:

WESTERN INDUSTRIAL LABORATORIES LIMITED

Frank Harrison

Frank Harrison

WESTERN INDUSTRIAL LABORATORIES LIMITED

LABORATORY REPORT

TELEPHONE
439-7969

8109 - 102 STREET
EDMONTON 62, ALBERTA T6E 4A4

WATER ANALYSIS REPORT

Company: W. J. Francl & Associates Date: 22 Sept. 72

Sample: Fort Simpson - Intake water Report No.: 221-32

Taken right beside Flygt pump 9:30 a.m. 25 Aug. 72 Lab. No.: 72-1522

Determination		ppm	Epm
pH	7.9		
Total dissolved solids		212	
Ignition loss		80	
Sodium & Potassium (Calc. as Na)		3	0.12
Calcium Ca		36	1.80
Magnesium Mg		9	0.74
Carbonate CO_3		Nil	—
Bicarbonate HCO_3		126	2.07
Alkalinity Total as $CaCO_3$		103	—
Sulphate SO_4		23	0.48
Chloride C1		4	0.11
Total Hardness as $CaCO_3$		127	—
Iron Fe		—	—
Fluoride F		—	—

Remarks: There was approximately 1/16" of sediment present in the bottom of the sample. Iron content of water after filtering through double #42 Whatman filter paper was 0.27. It was noted the filtrate still had a slight turbidity.

WESTERN INDUSTRIAL LABORATORIES LIMITED

Frank Harrison

Frank Harrison

WESTERN INDUSTRIAL LABORATORIES LIMITED

LABORATORY REPORT

TELEPHONE
439-7969

8109 - 102 STREET
EDMONTON ~~63~~ ALBERTA T6E 4A4

WATER ANALYSIS REPORT

Company: W. J. Francl & Associates Date: 22 Sept. 72

Sample: Liard River Report No.: 221-33

Taken near gravel pit 2:40 p.m. 25 Aug.72 Lab. No.: 72-1523

Determination		ppm	Epm
pH	7.9		
Total dissolved solids		226	
Ignition loss		88	
Sodium & Potassium (Calc. as Na)		4	0.16
Calcium Ca		36	1.80
Magnesium Mg		9	0.74
Carbonate CO_3		Nil	---
Bicarbonate HCO_3		126	2.07
Alkalinity Total as $CaCO_3$		103	---
Sulphate SO_4		25	0.52
Chloride Cl		4	0.11
Total Hardness as $CaCO_3$		127	---
Iron Fe		---	---
Fluoride F			

Remarks: There was about 1/16 to 1/8" sediment present in the sample. Iron test done on filtrate after passing through double #42 Whatman filter paper was 0.24. The filtrate still had a slight turbid appearance.

WESTERN INDUSTRIAL LABORATORIES LIMITED

Frank Harrison

Frank Harrison

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WESTERN INDUSTRIAL LABORATORIES LIMITED

LABORATORY REPORT

TELEPHONE
439-7969

8109 - 102 STREET
EDMONTON, ALBERTA
T6E 4A4

Attention: Jack Paterson

WATER ANALYSIS REPORT

Company: W. J. Francl & Associates Date: 8 Nov. 72

Sample: Spring water from Fort Simpson Report No.: 221-34

Lab. No.: 72-1806

Determination		ppm	Epm
pH	7.8		
Total dissolved solids		420	
Ignition loss		130	
Sodium & Potassium (Calc. as Na)		9	0.37
Calcium Ca		80	3.99
Magnesium Mg		24	1.97
Carbonate CO_3		Nil	—
Bicarbonate HCO_3		355	5.82
Alkalinity Total as $CaCO_3$		292	—
Sulphate SO_4		18	0.37
Chloride C1		5	0.14
Total Hardness as $CaCO_3$		299	—
Iron Fe	Supernatent - 0.4 After shaking - 1.6		—
Fluoride F		—	—

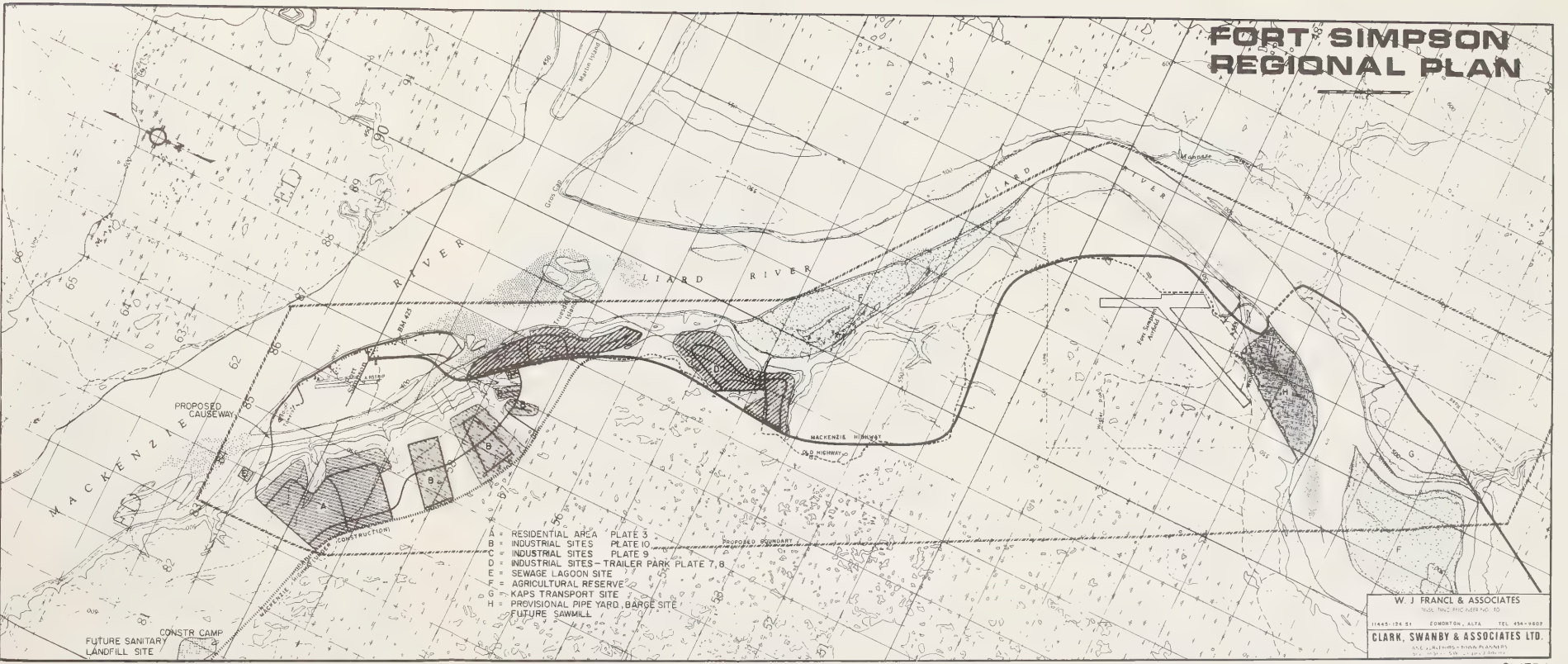
Remarks: Only about 110 ml. of water sample was submitted for analysis. Therefore smaller oliquots than is desirable had to be used for the analysis. We would prefer at least a quart sample. Iron test was done on the supernatent water as received (i.e. did not include sediment) and also on the sample after shaking to include sediment.

WESTERN INDUSTRIAL LABORATORIES LIMITED

Frank Harrison B.Sc.

Frank Harrison
193

FORT SIMPSON REGIONAL PLAN



W. J FRANCL & ASSOCIATES
11445-124 St EDMONTON, ALTA TEL 454-9609

CLARK, SWANBY & ASSOCIATES LTD.

PLATE 1

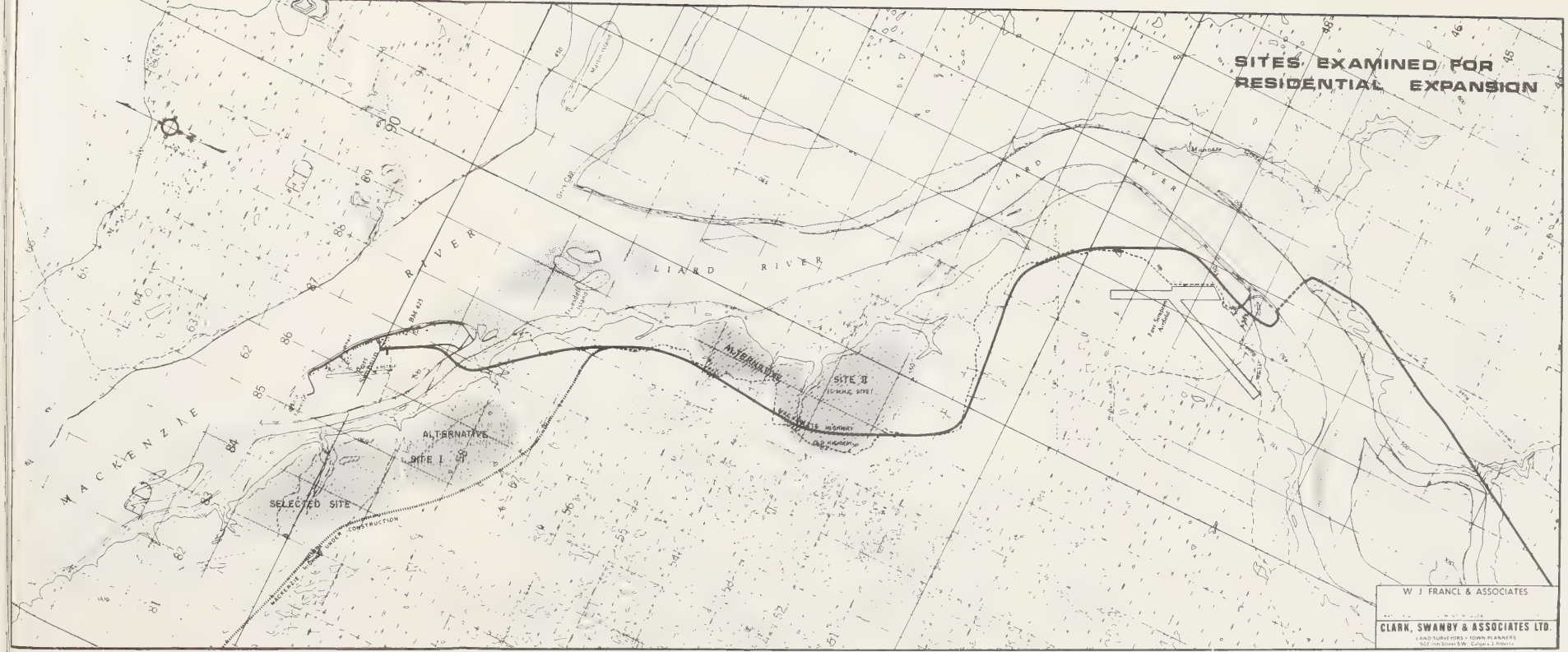

SITES EXAMINED FOR
RESIDENTIAL EXPANSION
LIARD RIVER
MACKENZIE
ALTERNATIVE
SITE I
SELECTED SITE
ALTERNATIVE
SITE II
W J FRANCL & ASSOCIATES
CLARK, SWANBY & ASSOCIATES LTD.
LAND SURVEYORS • TOWN PLANNERS

PLATE 2

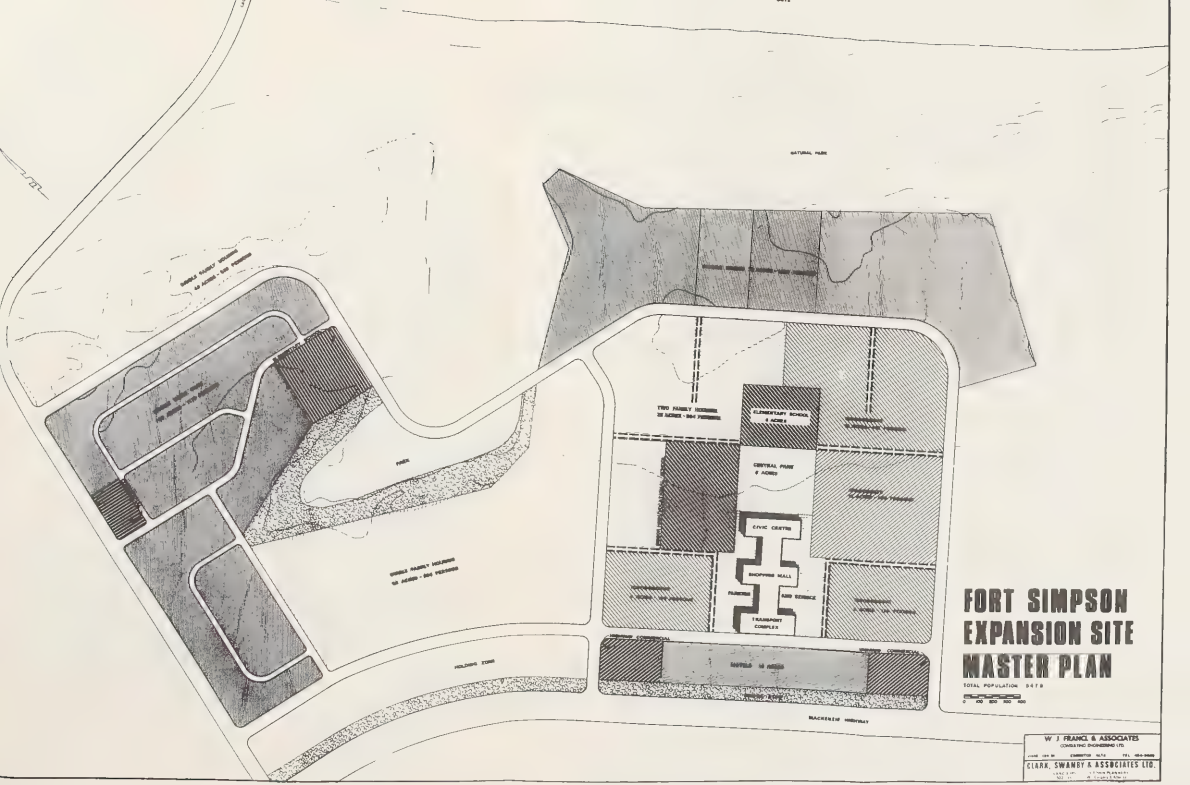

NATURAL PARK
SINGLE FAMILY HOUSING
10 ACRES - 120 PERSONS
SINGLE FAMILY HOUSING
10 ACRES - 120 PERSONS
PARK
SINGLE FAMILY HOUSING
10 ACRES - 120 PERSONS
HOLDING ZONE
TWO FAMILY HOUSING
20 ACRES - 240 PERSONS
ELEMENTARY SCHOOL
4 ACRES
CENTRAL PARK
4 ACRES
CIVIC CENTRE
SHOPPING MALL
PUBLIC
AND SERVICE
TRANSPORT
COMPLEX
HOTEL 10 ACRES
MACKENZIE HIGHWAY
FORT SIMPSON
EXPANSION SITE
MASTER PLAN
TOTAL POPULATION 9478
0 400 800 1600 2400
W J FRANCL & ASSOCIATES
CONSULTING ENGINEERING LTD.
CLARK, SWANBY & ASSOCIATES LTD.

PLATE 3


TO ISLAND
1
ELEMENTARY SCHOOL
STORAGE COMPOUND
RECREATION AREA
RECREATION AREA
RECREATION AREA
PARK
COMMERCIAL EXC
2
Suggested layout
7 units per acre backing
onto a central recreational
area plus parking
FORT SIMPSON MOBILE HOME PARK PHASES 1 & 2
0
400
W. J. FRANCL & ASSOCIATES
CONSULTING ENGINEERING LTD
11445 124 St EDMONTON, ALTA TEL 454-8602
CLARK, SWANBY & ASSOCIATES LTD.

PLATE 4

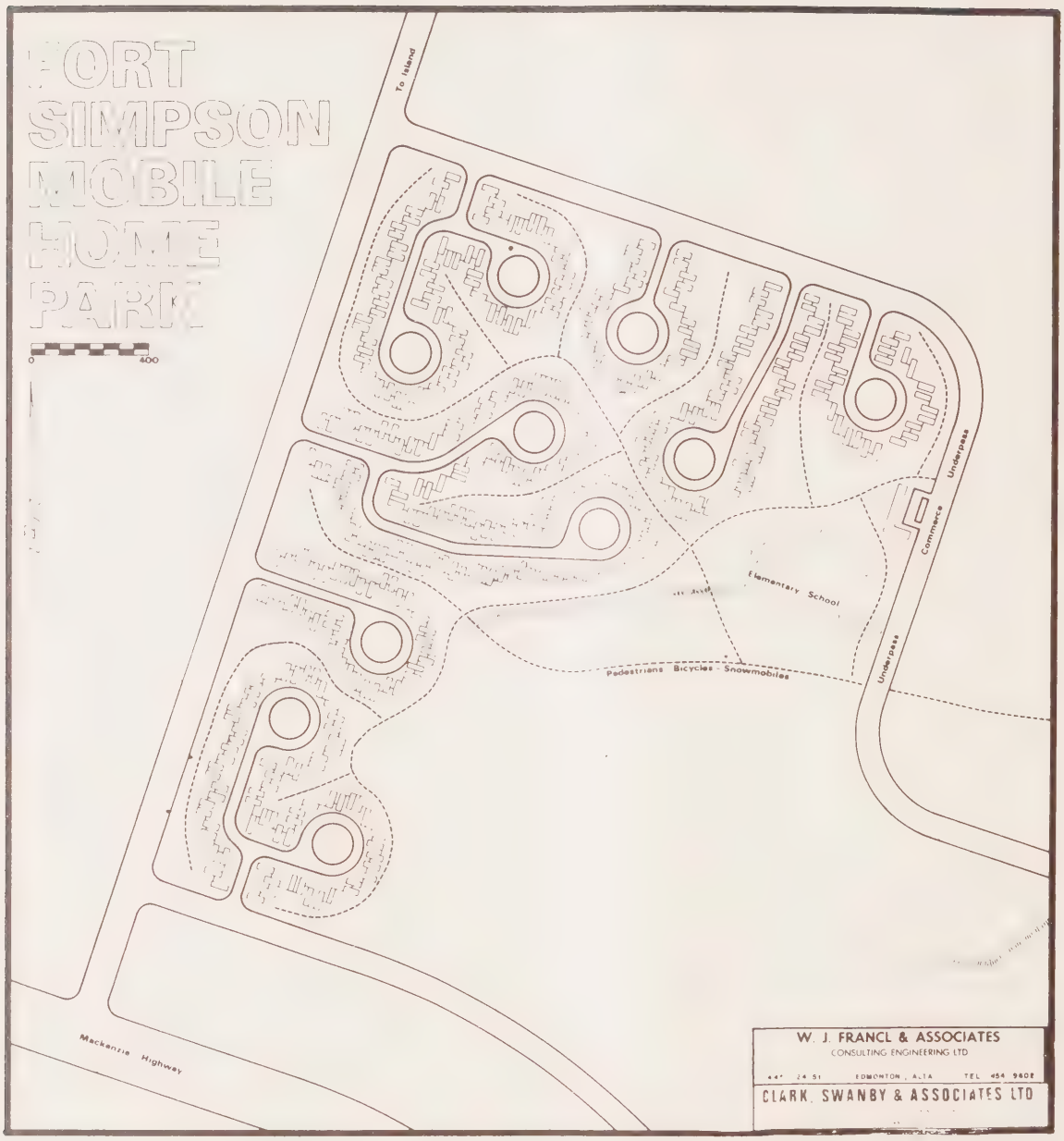
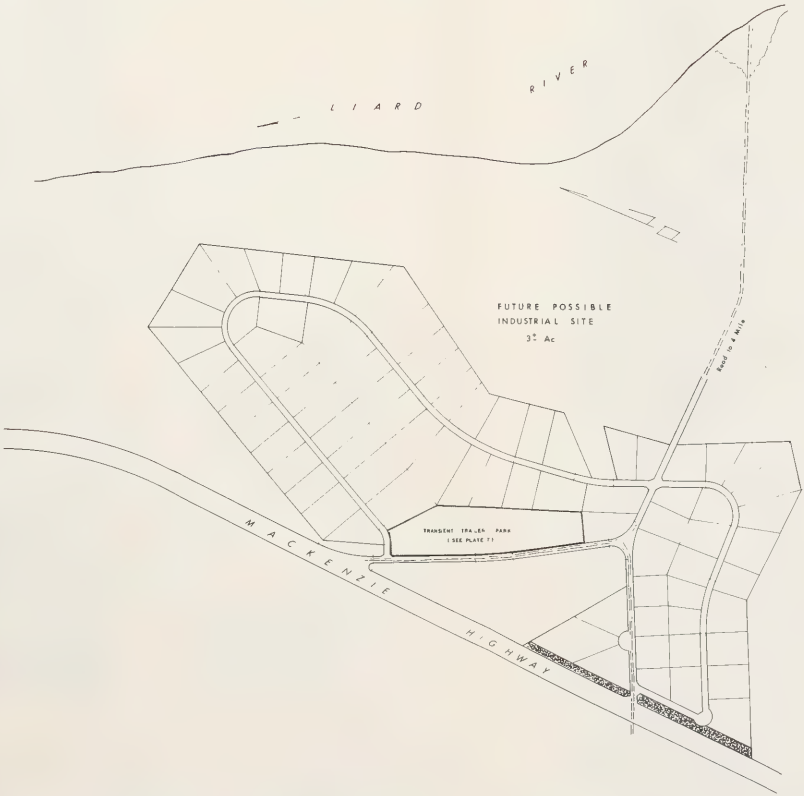

FORT SIMPSON MOBILE HOME PARK
0
400
To Island
Commerce
Underpass
Underpass
Elementary School
Pedestrians Bicycles Snowmobiles
Mackenzie Highway
W. J. FRANCL & ASSOCIATES
CONSULTING ENGINEERING LTD
EDMONTON, ALTA
TEL 454 9602
CLARK, SWANBY & ASSOCIATES LTD

PLATE 5



FORT SIMPSON

PROPOSED 4 MILE INDUSTRIAL SITE

Scale

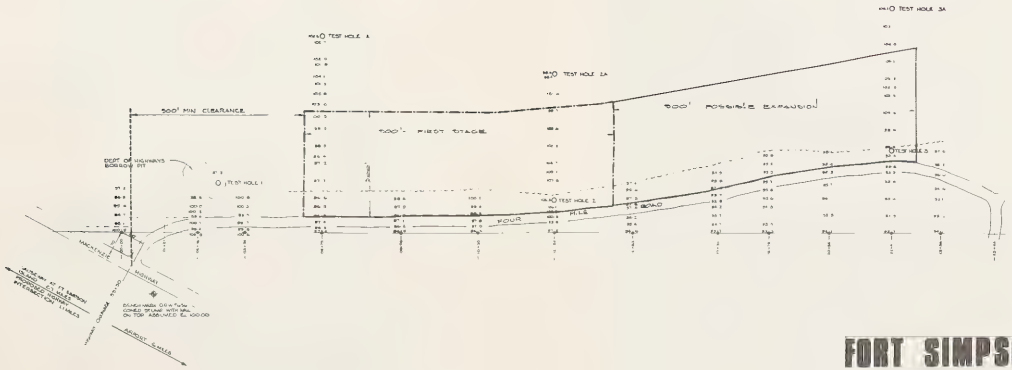
NOTE
THE DESIGN IS SUBJECT TO GROUND INSPECTION

BUFFER ZONE

W J FRANCL & ASSOCIATES
CONSULTING ENGINEERING LTD

CLARK, SWANBY & ASSOCIATES LTD

PLATE 6



LEGEND

EXISTING OVERHEAD POWER LINE

EXISTING SPOT ELEVATION

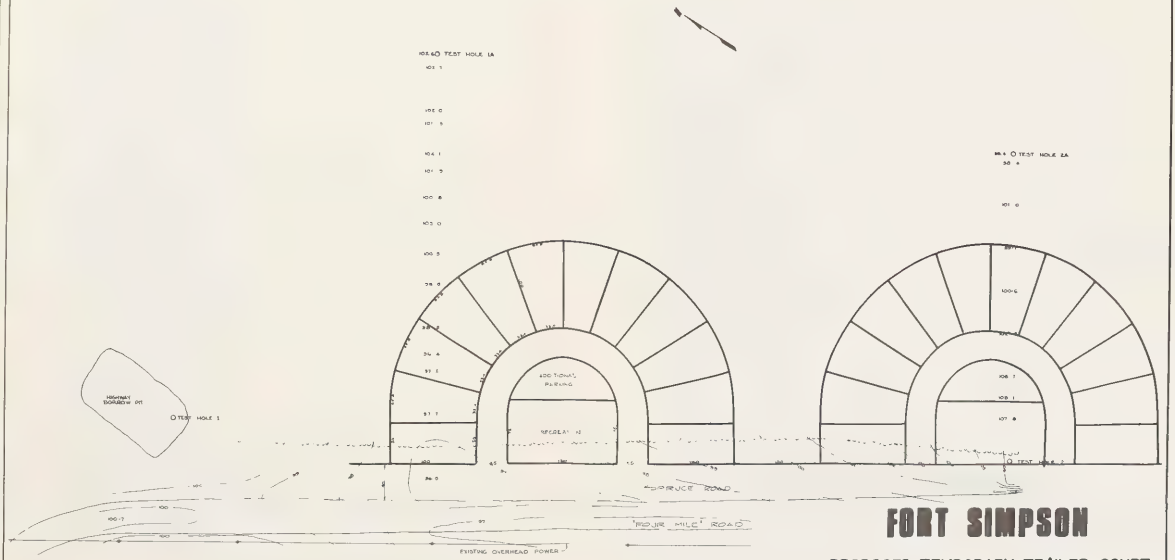
FORT SIMPSON

PROPOSED TEMPORARY TRAILER COURT

COURT LOCATION

W. J. FRANCI & ASSOCIATES
CIVIL & MINE ENGINEERING LTD.

PLATE 7



NOTE: BENCHMARK FOR SPOT ELEVATIONS AND CONTOURS IS DATUM B.M.C.# 6006 HELD AS TOP OF CORNER OF PUMP AT HIGHWAY INTERSECTION ASSUMED EL. 100.0

FORT SIMPSON

PROPOSED TEMPORARY TRAILER COURT

TYPICAL LOT ARRANGEMENT

W. J. FRANCL & ASSOCIATES
CONSULTING ENGINEERING LTD.

PLATE 8

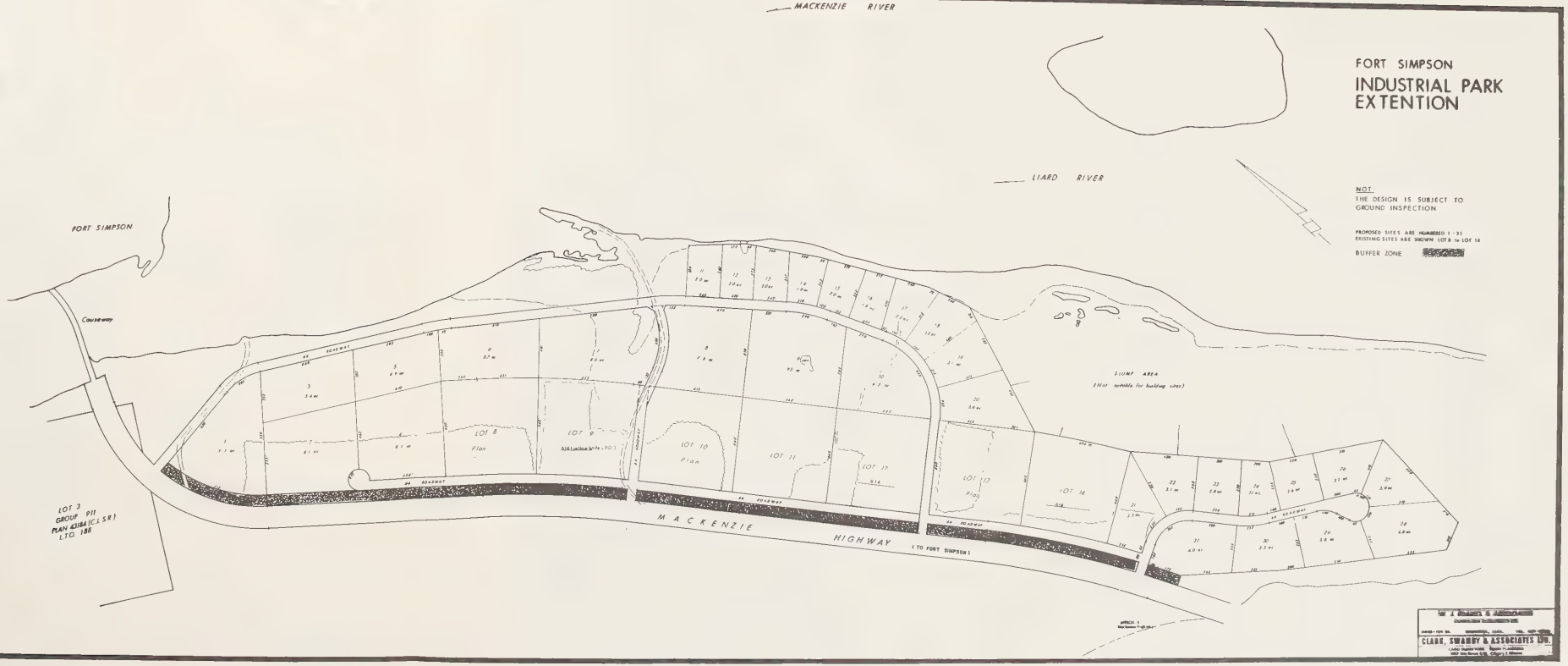
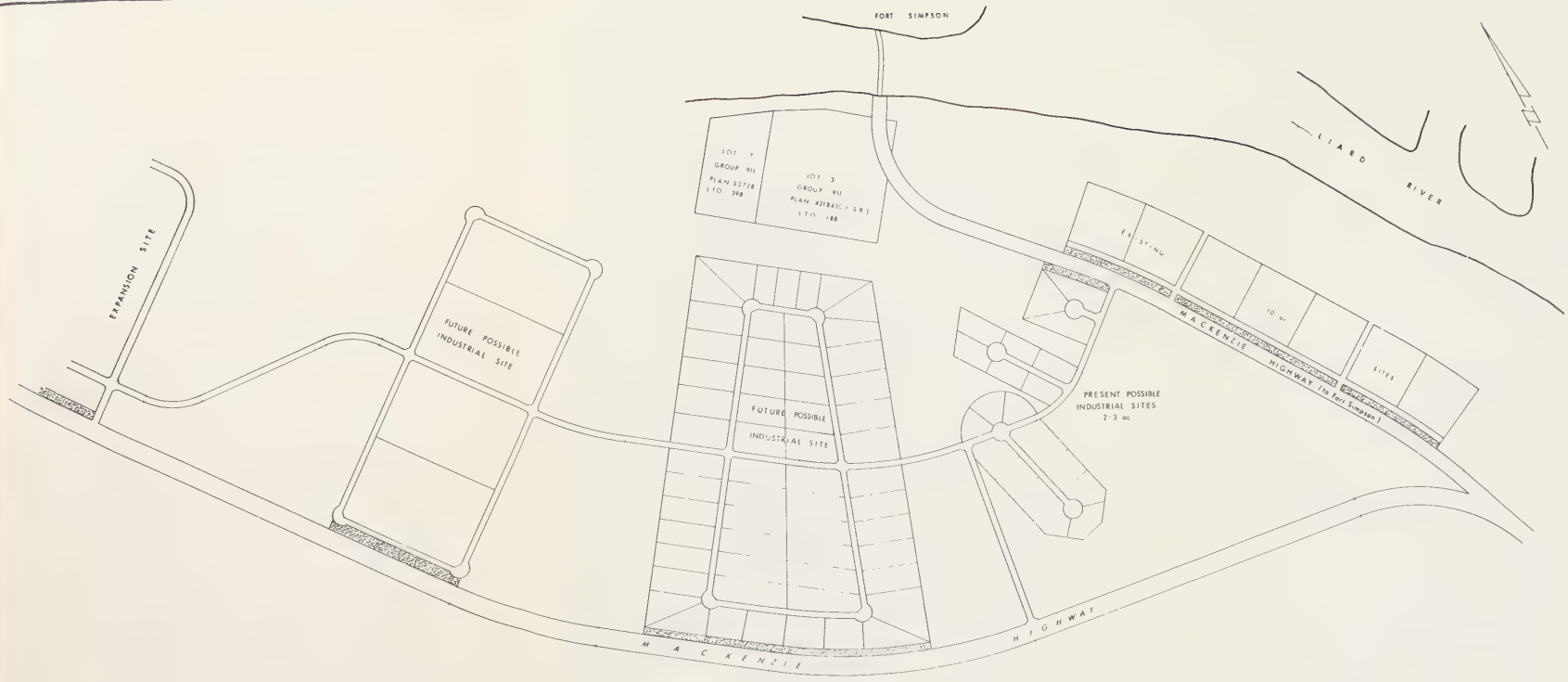

MACKENZIE RIVER
LIARD RIVER
FORT SIMPSON
Causeway
FORT SIMPSON
INDUSTRIAL PARK
EXTENTION
NOTE
THE DESIGN IS SUBJECT TO GROUND INSPECTION
PROPOSED SITES ARE NUMBERED 1 - 31
EXISTING SITES ARE SHOWN LOT 8 to LOT 16
BUFFER ZONE
SLUMP AREA
(Not suitable for building sites)
LOT 8
LOT 9
LOT 10
LOT 11
LOT 12
LOT 13
LOT 14
LOT 15
LOT 3
GROUP 911
PLAN 43184 (C.L.S.R.)
L.T.O. 188
MACKENZIE HIGHWAY (TO FORT SIMPSON)
CLARK, SWANBY & ASSOCIATES LTD.

PLATE 9

24742



FORT SIMPSON

INDUSTRIAL PARK BETWEEN THE FORT SIMPSON & MACKENZIE HIGHWAYS

Scale

NOTE
THE DESIGN IS SUBJECT TO GROUND INSPECTION

BUFFER ZONE

NOTE THIS DRAWING IS A SCHEMATIC LAYOUT ONLY NOT A DETAIL

W. J. FRANCI & ASSOCIATES

CLARK, SWARBY & ASSOCIATES LTD

PLATE 10